THURSDAY, APRIL 1, 1915.

THE DEVELOPMENT OF THE INVERTEBRATES.

Text-book of Embryology. Edited by W. Heape. Vol. i. Invertebrata. By Prof. E. W. MacBride. Pp. xxxii+692. (London: Macmillan and Co., Ltd., 1914.) Price 25*s.* net.

THE appearance of Balfour's great work on comparative embryology in 1880 marked an epoch in the history of zoology. Since then not only has a vast quantity of new information been acquired, but whole new branches of the study have been developed. For instance, we now have the science of experimental embryology, which aims at discovering the conditions and regulative processes of differentiation and development—a science founded by Roux, Driesch, and others; while to E. B. Wilson and other American observers we owe the study of cell-lineage, whereby the prospect is opened up of being able to trace back homologous organs not merely to germ-layers, but to corresponding individual cells in the early history of the embryo. To give a clear and concise account of these modern researches is indeed a difficult task. Prof. MacBride is the first Englishman to make the attempt, and it may be said at once that he has been, on the whole, most successful.

The descriptions are remarkably lucid, and easy to understand with the help of an abundance of really excellent illustrations. Each chapter deals with a separate group. After a brief introduction, it begins with as complete an account as possible of the whole development of a typical example, from egg to larva, and from larva to adult. Other forms are then briefly compared with the type, and there follows a discussion of the general features of the embryology, of their phylogenetic significance, and of the affinities of the group. There is much to be said for this mode of treatment. The story of the development is continuous, and the reader is presented with a very complete picture of the ontogeny of a representative of each group. At the same time there is some danger that he may not fully realise how much diversity of development there often is among closely allied animals; and that the type chosen may be, and indeed often is, the most specialised. Following the history of normal development, we also find in many chapters an interesting discussion of the results of experimental embryology. Here and there the text is varied with useful notes on the occurrence and habits of larvæ, and on methods of collecting and preserving material.

Such a work is bound to show weak points, and the chapters are certainly of unequal merit. Readers will turn with special interest to the part devoted to Echinoderms, since Prof. MacBride's important researches on these animals are well known. They will not be disappointed, but will find, we think, the best account of the embryology of the Echinoderms yet published in any text-book. On the other hand, certain obscurer groups are altogether omitted, or are scarcely mentioned. Considerations of space may, no doubt, have compelled the author to aim rather at giving a full history of the more important forms than at completeness. But we venture to think that it would have been better to devote more attention especially to organogeny in the earlier chapters, and to have collected the parts dealing with experimental work into a separate volume. For the general questions, which the experiments are designed to elucidate, are far better discussed as a whole than piecemeal in the various chapters. Want of space has also prevented Prof. MacBride from giving any historical account of the subject, from referring in most cases to any but the most recent publications, and from providing a fuller bibliography.

Knowing what difficulties the writer of a text-book has to contend with, it is an ungrateful task to find fault with so excellent a work. Yet some points may be mentioned which might well be improved in a second edition. We doubt whether the reader of the chapter on the Porifera would gather that there takes place in many sponges the remarkable developmental process known as the "inversion of the layers," so well described by Delage, Minchin, and Maas. Since he admits, we believe quite rightly, that the Ectoprocta and Endoprocta are independent phyla "not descended from a common fixed Polyzoon ancestor," why has not the author the courage to separate them, following the example of some of his predecessors? Again, we find the Opisthogoneata and the Progoneata still joined in the artificial group Myriapoda. Such conservatism obscures the issue, and hinders progress. We wonder, also, why he retains the word nephridium, even in inverted commas, for the segmental ducts of Peripatus, derived from the cœlomic wall, and not homologous with the nephridia of the earthworm to which Lankester first gave the name. Indeed, the whole question of the nephridia, their development and homology, seems to be very inadequately treated. Here the author appears to be treading on unfamiliar ground, and to be insufficiently acquainted with the literature on the subject. Even less satisfactory is Prof. MacBride's discussion of the cœlom. Its origin is vaguely referred to the radial enteric chambers of some

remote Cœlenterate ancestor. The author appears to forget that these chambers are formed in a fundamentally different way and order, by the ingrowing of mesenterial folds. Moreover, one of the many serious objections to this theory is that it fails utterly to bridge over the gap between the Cœlenterate and the Cœlomate, and leaves quite unexplained the structure of the Platyhelminth and Nemertine. It is just here that the Gonocœle theory has proved so valuable, giving the only intelligible interpretation of the morphology of these lower forms, founded not on vague speculations, but on the comparison of well-established facts in comparative anatomy. This theory, founded and supported by Hatschek, Ed. Meyer, Lang, and many others, Prof. MacBride dismisses with scorn, and the remarkable statement that any vogue it has obtained "is only in consequence of the myopic concentration of attention on the facts of development in a limited number of groups, and the neglect of the facts of development in other groups" (p. 166).

The suggestion made on p. 661 that the diverticula of the gut in the Platyhelmia represent the cœlom takes us back some thirty years to a time before the structure of these animals was understood, besides being in direct opposition to the teaching of cell-lineage so clearly described in this very volume. The determination of the homology of the mesoblast cells in Platyhelminths, Nemertines, Annelids, and Molluscs is surely one of the most important contributions of modern embryology to the morphology of the Invertebrata.

The author is less happy in his phylogenetic speculations than in his descriptions of development. So much is he under the influence of the recapitulation theory that almost all free-swimming larvæ appear to him as scarcely modified ancestral forms. It need scarcely be pointed out that the mere prevalence of a common larval form in one or several groups of animals does not in itself prove that this larva closely resembles the adult common ancestor. It may be taken as good evidence that the ancestor also possessed such a larval stage, and is therefore an indication of the close affinity of the animals concerned. Beyond this it is unsafe to theorise without other evidence from comparative anatomy or palæontology. It should never be forgotten that ancestors were not larvæ, but self-supporting adults capable of reproduction. Prof. MacBride would have done better to follow the example of Sir Ray Lankester, who long ago, when he reconstructed his famous Archi-mollusc, took as his model not the trochosphere nor even the veliger larva, but a creeping animal. If we adopted the author's theories as to the ancestral significance of larval forms, we should have to suppose that a large number of the characters held in common by the various groups have been independently developed, a conclusion for which there would seem to be no justification.

When discussing general questions in a final chapter Prof. MacBride appeals to hormones as affording a rational explanation of the *modus operandi* for the supposed "inheritance of acquired characters." This view is, of course, not new; Delage, Vernon, and Cunningham have in turn supported it. But, quite apart from the evidence of such inheritance, it is difficult to see how these internal secretions could become incorporated into the blastogenic factors of development.

We congratulate both the author and the editor on the production of this handsome text-book. It will doubtless be warmly welcomed by all English-speaking students and teachers of embryology, and take the place it deserves among the standard works on the subject.

E. S. GOODRICH.

THE BUTTERFLIES OF AUSTRALIA.

The Butterflies of Australia: a Monograph of the Australian Rhopalocera. By G. A. Waterhouse and G. Lyell. Pp. vi+239+plates. (Sydney: Angus and Robertson; London: Oxford University Press, 1914.) Price 42*s.* net.

THE scientific study of the butterflies of Australia is certain to be greatly advanced by the appearance of this admirable work, although it is to be feared that the high price will tend to prevent a very wide circulation. It is obvious, however, that a costly book is implied by the presence of forty-three excellent quarto plates, of which four are coloured. In addition to this abundant and most necessary illustration in plates, the reader is provided with numbers of text figures as well as a valuable map-index of localities. One of the plates is devoted to larvæ and pupæ, one coloured plate to the variations of the Satyrine butterfly *Tisiphone joanna*, the three others to special Satyrinæ, Lycænidæ, and Hesperidæ. The remaining thirty-eight uncoloured plates contain 793 figures, all natural size, of the 332 species recognised by the authors as at present known in Australia.

Especial attention has been given to geographical distribution, and the authors have made a point of examining long series of specimens wherever available. In this work they have received help from many students of the Australian Rhopalocera, while Mr. Waterhouse's extremely fine collection, seen by the present writer during the recent visit of the British Association, has

clearly been developed with the object of producing this volume.

The trinominal system of nomenclature, the principles of which are clearly explained in the introduction, is followed by the authors as by most naturalists who have made a special study of geographical distribution. At the same time, new subspecies or geographical races have only been created when plenty of material was available. The authors have wisely deemed it "preferable that a race should continue undetermined rather than the racial characters should be wrongly described or a new race erected on insufficient grounds."

The exigencies of space prevent any detailed discussion or description of the work, but it must be mentioned that the remarkable *Euschemon* is considered as a "Skipper" (Hesperidæ) and not as a moth. This conclusion appears to the present writer to be entirely sound, although the primary division of Lepidoptera into "butterflies" and "moths" is, of course, artificial and merely a matter of convenience.

In addition to the description of the species and the groups to which they belong, occupying nearly the whole of the volume, there is an introductory section with a brief historical account of Australian work and an excellent general description of the Lepidoptera, together with the anatomical features relied upon by the systematist. A concluding section, with "Notes upon Collecting and Collections," complete the work by rendering it a sufficient guide to the beginner.

The keen Australian naturalist is now provided with a foundation upon which to build. The present work will tell him what he is dealing with, and will indicate much of the work that remains to be done. Blank records of food-plants and of larval and pupal stages will suggest, to those interested in breeding, one of the most fascinating of all inquiries. We may hope that the bionomic problems presented by the Australian Lepidoptera, as yet scarcely attacked at all, will now receive attention; that geographical variation, so specially studied by the authors, will forthwith be advanced by the efforts of a band of new observers.

The naturalist living in the cooler parts of Australia need not be discouraged by comparing his species with the grander forms of the tropical north. These latter are for the most part identical with or very closely allied to Papuan species, while his own less magnificent butterflies are characteristic of the great southern continent. At the same time, the resident in northern Queensland has the opportunity of solving complex problems of tropical life with its elaborate inter-relationships —an opportunity of which Mr. F. P. Dodd has taken such great advantage. With the present work as a guide we may look forward to a rapid advance along many lines in our knowledge of the butterflies of Australia. E. B. P.

PHYSICAL ANTHROPOLOGY.

Lehrbuch der Anthropologie in Systematischer Darstellung. Mit besonderer Berücksichtigung der anthropologischen Methoden für studierende Aerzte und Forschungsreisende. Von Prof. R. Martin. Pp. xvi+1181. (Jena: G. Fischer, 1914.) Price 35 marks.

IN these later years the Anthropological Institute of the University of Zürich has acquired a very high reputation amongst anthropologists. The success of Zürich as a centre of anthropological research and teaching is due to Prof. Rudolf Martin who, these twenty years past, has gathered round him and trained a band of young men, who are now spreading abroad the reputation of the new Swiss school.

In the work under review, Prof. Martin gives a systematic account of twenty years of experience as an expert anthropologist, detailing his methods of measurement, his manner of making records and describing the principles on which his methods are based. His text-book is much more than a technical manual; it is really an encyclopædia of knowledge relating to the size and shape of body in all races of mankind. There was great need for a standard work on physical anthropology; Prof. Martin has supplied that need.

The modern conception of the scope of physical anthropology and the relative importance attached to each of its branches will be made clear by a summary of the contents of Prof. Martin's text-book. The largest section is given to the skull; 422 pages out of a total of 1069 are devoted to the methods and results of craniology. The next important section is that which deals with the living body—its measurements, proportions, pigmentation, growth, etc.; to this subject considerably more than a third of the total book is assigned. A separate section is devoted to a consideration of the skeleton—189 pages. Thus, the major part of this work is devoted to the skull, skeleton, and external characters of the body.

The two opening sections, although condensed —amounting altogether to 102 pages—are both useful and important. These opening sections deal with anthropological methods, particularly with the best means of expressing results in graphic and in mathematical forms. The classi-

fication of human races, the relationship of man to other mammalian forms, and the origin and progress of anthropological knowledge are discussed briefly but yet at sufficient length to meet the needs of the average student. A. K.

MONOGRAPHS AND TEXT-BOOKS OF CHEMISTRY.

(1) *Nucleic Acids: their Chemical Properties and Physiological Conduct.* By Prof. W. Jones. Pp. viii+118. (Monographs on Biochemistry.) (London: Longmans, Green and Co., 1914.) Price 3*s.* 6*d.* net.

(2) *The Simpler Natural Bases.* By Prof. G. Barger. Pp. viii+215. (Monographs on Biochemistry.) (London: Longmans, Green and Co., 1914.) Price 6*s.* net.

(3) *The Chemistry of the Radio-Elements.* By Prof. F. Soddy. Second edition. Part i. (London: Longmans, Green and Co., 1914.) Price 4*s.* net.

(4) *Encyclopédie de Science Chimique Appliquée.* Tome v., "Principes d'Analyse et de Synthèse en Chimie organique." By M. Hanriot, Prof. P. Carré, and others. Pp. 795. (Paris et Liège: Ch. Béranger, 1914.)

(5) *The Principles of Inorganic Chemistry.* By W. Ostwald. Translated with the author's sanction by Prof. A. Findlay. Fourth edition. Pp. xxxiii+836. (London: Macmillan and Co., Ltd., 1914.) Price 18*s.* net.

(6) *The Chemistry of Cyanogen Compounds and their Manufacture and Estimation.* By H. E. Williams. Pp. viii+423. (London: J. and A. Churchill, 1915.) Price 10*s.* 6*d.* net.

(7) *Advanced Inorganic Chemistry.* By P. W. Oscroft. Pp. viii+504. (London: G. Bell and Sons, Ltd., 1915.) Price 5*s.* net.

(8) *Preparations and Exercises in Inorganic Chemistry.* By W. Lowson. Pp. vii+128. (London: Methuen and Co., Ltd., 1914.) Price 2*s.* 6*d.*

(9) *A Manual of Chemistry: Theoretical and Practical, Inorganic and Organic.* Adapted to the requirements of students of medicine. By Dr. A. P. Luff and H. C. H. Candy. Pp. xix+660. Fifth edition. (London: Cassell and Co., Ltd., 1915.) Price 8*s.* 6*d.* net.

(1) and (2) THE subject of biochemistry, like many other branches of knowledge, has already extended to dimensions which effectively prevent any one author from doing justice to more than a part of the subject. Under these conditions it has been usual to witness the production of a text-book in which a general editor has distributed the work amongst a number of colleagues. The two monographs now under review are excellent examples of a better method of treatment. The publication of a series of smaller monographs provides just that flexibility which is required by a rapidly-growing subject; topics which are not yet ripe for description in a text-book can be held over to await further development, whilst individual sections can be revised and brought up to date without rendering obsolete a whole edition of many volumes.

Prof. Jones's monograph on the "Nucleic Acids" provides a fascinating story both for chemists and for physiologists, and affords a revelation of the amount of definite knowledge that is now coming into existence in reference to the chemical composition of plant and animal bodies.

It is very interesting to watch what materials are used in nature for the building up of living tissues. In the present case one of the most important sugars has been proved to be *d*-ribose (hitherto not known to chemists), whilst the bases belong to the pyrimidine series or are related to uric acid; the formula for the last substance is written in an unfamiliar form, with a hexagonal nucleus, which suggests a real analogy with the bases of the indol and skatol series. The inclusion of a bibliography covering sixteen pages of text will show how extensive is the literature on which this compact volume is based.

Prof. Barger's monograph covers a more extensive field, and is based on a bibliography which extends over 44 pages of text. These simpler bases are related in some ways to the alkaloids. They are distributed much more widely, but must be extracted by different methods. For this reason they were not recognised until a much later date; but, once identified, they are often capable of synthetical preparation on a large scale. Few things, in the recent growth of biochemistry, are more remarkable than the proof that has been given of the simple chemical character of many substances of intense physiological activity. The most striking case is that of adrenaline, but there is reason to believe that other internal secretions owe their activity to bases of comparatively small molecular weight. If this should be the case, the study of these bases may prove to be of even greater importance than that of the amino-acids which bulk so largely in the structure of the proteins.

(3) The appearance of a second edition of Prof. Soddy's monograph on the radio-elements is an indication of the rapid growth of the subject with which it deals. Many new members have been added to the disintegration-series, but there is reason to think that something approaching completeness has now been attained, and that further study will be devoted mainly towards an increased

knowledge of these elusive elements, some forty of which are crowded into ten places of the conventional periodic classification.

(4) The French book on analysis and synthesis is the fifth volume of an Encyclopædia of Applied Chemistry. It includes five sections on "Organic Analysis," by M. Hanriot; "Pharmaceutical Products," by P. Carré; "Synthesis of Colouring Matters," by A. Sergewetz; "Production of Perfumes," by E. Charabot; "Saponification," by A. Hébert. It is therefore in reality a series of five monographs, bound together in one volume and grouped under a convenient general title. It forms a companion to a similar volume on the theory and practice of mineral analysis, but might with advantage have been issued in separate parts, as it is unlikely that many workers would attempt to cover the wide field included in this volume.

(5) Prof. Ostwald's "Principles," of which a fourth edition is now published, is an inorganic chemistry written from the point of view of the physical chemist. The ionic hypothesis occupies a place of honour throughout the volume. In the new edition a final chapter on the radio-active elements contains a somewhat full account of the three chief disintegration-series of radio-elements.

(6) Mr. Williams' book on the cyanogen compounds contains a detailed description of this important series of compounds, arranged somewhat in the manner of a dictionary. Thus under the heading of "Thiocyanates," details are given as to the composition and properties of thirty-two simple salts and a far larger number of double salts. The author has made a number of experiments himself, the results of which are now described for the first time, the "petty restrictions" and "stereotyped methods" of the scientific societies having prevented him from publishing them through the usual channels. Fortunately, he has been able to avail himself freely of the work of others who have faced these obstacles. The book is therefore generously supplied with references to original literature, which render it a valuable guide to the subject with which it deals.

(7) Mr. Oscroft's book suffers from an unfortunate title. Intended primarily for senior classes of boys, it is described in the title as an "advanced inorganic chemistry," and in the text as a "Chemistry for advanced students." Such a description is misleading in the case of a book which devotes only one page to the Periodic Law, four pages to radio-activity, and five pages to spectrum analysis. Apart from this obvious error the book is a good example of the class of school text-books to which it really belongs. The author is in touch with the historical treatment, which is now becoming so important in the teaching of elementary chemistry, and promises also to effect, on the theoretical side, an improvement comparable with that which has resulted from the introduction in the laboratory of experiments based largely on the classical work of Scheele, Cavendish, and Priestley. The illustrations are scarcely equal to the standard of the text, and are not improved by labelling the gases as H, N, O, etc., in direct defiance of their recognised molecular formulæ. The formulæ given on p. 223 for persulphuric acid should be H_2SO_5 (monobasic) and $H_2S_2O_8$ (dibasic), and the preparation on p. 242, described and indexed under persulphuric acid, refers obviously to pyrosulphuric acid.

(8) The instructions used in the chemical laboratories at Leeds in the teaching of elementary students have been expanded by Mr. Lowson into a small volume intended primarily for local use, but likely to prove acceptable in other laboratories where similar work has to be carried out. The book consists mainly of simple preparations, which are described in detail in order to economise the time of the teacher and to enable him to accommodate the course to the varying abilities of different students. Theoretical questions suggested by the experiments are, however, referred to from time to time, and a large number of additional exercises are provided in connection with the different preparations.

(9) Luff and Candy's "Chemistry for Students of Medicine" shows a marked improvement in each successive edition. The condensation of the whole of the chemical theory, including the periodic classification of the elements, into one preliminary section does not provide a practicable basis for actual class-teaching; but it may well prove convenient to a student who wishes to revise what he has learnt in a course of lectures arranged on a gentler gradient. Historical references are more frequent than in the earlier editions, as the author has found that these interest the student, and also enable him to trace the evolution of the fundamental principles of chemistry, and thus appreciate their full significance. T. M. L.

OUR BOOKSHELF.

The Germ-cell Cycle in Animals. By Prof. R. W. Hegner. Pp. x+346. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1914.) Price 7*s.* 6*d.* net.

In this interesting book Prof. Hegner gives a very complete and clear account of the origin, structure, and continuity from generation to generation of the reproductive cells of the Metazoa. Owen appears to have been the first clearly to point out that the fertilised ovum gives rise to two kinds of cells: the first destined to form the differentiated tissues of the new individual, the second

remaining relatively unchanged and destined to propagate the race. Recent investigations, to which the author has made valuable contributions, tend to show that the distinction, once established, is irrevocable, and that germ-cells are derived from pre-existing germ-cells in an unbroken stream—the germ-track. Modern methods have enabled investigators to trace the appearance of germ-cells to earlier and earlier stages in development, thanks to certain distinctive characters of the cytoplasm or nucleus. The name keim-bahn determinants, or germ-track determinants, as we should prefer to call them, is given to such recognisable features in the cells. Although in some animals, such as Ascaris and Sagitta, the germ-cells have been traced back to the very early embryo consisting of only a few cells, the complete segregation of the germ-forming substance has not yet been observed in the first cleavage of the egg into two cells.

Having given an excellent review of the evidence on this subject, Prof. Hegner proceeds to discuss the significance of the germ-track determinants, the chromosomes and mitochondria of germ-cells, the determinants of sex, and kindred questions. No doubt the most interesting problems relate to the possible identification of factors which determine the fate of cells—whether they will become germ-cells or body-cells, ova or spermatozoa, and also the fate of individuals—whether they will become males, females, or hermaphrodites. Through no fault of the author these problems are left unsolved. But concerning the germ-plasm theory itself he is confident that it rests on a firm basis, while inclined to believe that the germ-plasm resides not in the nucleus or chromosomes alone, but also in the cytoplasm.

Quain's Elements of Anatomy. Eleventh edition. Vol. iv, Part 1. *Osteology and Arthrology.* By Dr. T. H. Bryce. Pp. viii + 329. (London: Longmans, Green and Co., 1915.) Price 12*s.* 6*d.* net.

IN the latest (eleventh) edition of "Quain's Anatomy"—a standard work—there have been several alterations, one of them being the inclusion of the chapters giving a descriptive account of the joints with the volume devoted to the skeleton of the human body. Part 1 of Vol. iv., which has just appeared under the editorship of Prof. T. H. Bryce, thus gives a systematic account of the bones and joints of the human body. We are very glad to note that the editor gives a fairly full list of the more important of recent publications—an essential feature of a standard work. Prof. Bryce has done well in retaining the excellent drawings which Mr. D. Gunn, Dr. T. W. P. Lawrence, and Prof. G. D. Thane contributed to the last edition, and has improved the chapters dealing with the joints by the use of new coloured plates prepared by Mr. A. K. Maxwell. Another decided improvement is the introduction of an account of the development of the various parts of the skeleton in the chapters devoted to descriptions of the bones. The investigations of Prof. Fawcett and of Dr. Alex. Low have been incorporated in the new text. Altogether, this volume of the new "Quain" will be welcomed by teachers and students of anatomy.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Rules of Zoological Nomenclature.

As one of the British members on the International Commission for Zoological Nomenclature, I have frequently been asked where copies of the rules as revised and adopted at the Monaco Congress are to be obtained in separate form. May I therefore use your widely-read columns to inform zoologists (including palæontologists) that a translation into French, the official language, has been made by Prof. R. Blanchard, in agreement with the secretary to the Commission, and has been published in the *Revue critique de Paléozoologie*, edited by Mr. Maurice Cossmann, 110 Faubourg Poissonnière, Paris X? Reprints may be purchased, at a price of 4*s.*, from Messrs. Dulau and Co., Ltd., 37 Soho Square, London, W. Mr. Cossmann has added some useful notes, especially from the point of view of the palæontologist, but these, it should be remembered, have no authority from the Congress or the Commission.

F. A. BATHER.

Natural History Museum, South Kensington, S.W., March 30.

The Preparation of Anhydrous Solids.

THE following method may perhaps be of use to chemists and biologists who are concerned in the preparation of solid compounds in the anhydrous state for analysis, or in obtaining anhydrous tissues for moisture determinations, etc. It consists in utilising Prof. S. Young's process for the purification of alcohol from all water by distilling it through his evaporator still-head, with the previous addition of a suitable quantity of benzene.

The tissue or compound to be dehydrated is placed in the distillation flask with alcohol and benzene in the proper proportions. When all the turbid ternary mixture of constant boiling point has been removed, by distillation from a water-bath, the remaining mixture of alcohol and benzene may be rapidly distilled away, and the last traces can be removed in a vacuum desiccator. By adjusting the quantities either alcohol or benzene can be obtained as the residual liquid, and the complete removal of either of them is far more readily effected than is that of water owing to their lower boiling points and greater volatility.

The method avoids all risk of oxidation, a source of serious error when plant tissues are dried at 100° C. in air. It appears that this procedure can be adopted for quantitative determinations in many cases, and may throw light upon the existence of water as "water of crystallisation" or as "water of constitution." These points are at present being studied by Miss E. G. Wilson and the writer.

W. R. G. ATKINS.

University Chemical Laboratory, Trinity College, Dublin.

THE WAR AND BRITISH CHEMICAL INDUSTRY.

OWING to the urgency of the aniline dye question and the discussion which has been taking place on the Government scheme, it has been thought expedient to issue part iv. of a memorandum dealing with the entire question of the "War and British Economic Policy." It is published by Messrs. P. S. King and Son, of Westminster, and a brief summary of it is given in the *Chemical News* of February 26. British industries use annually dyes to the value of nearly 2,250,000*l.*, of which about 1,750,000*l.* come from Germany, about 150,000*l.* from Switzerland, and only about 200,000*l.* are of British home production. Aniline dyes constitute an indispensable material in many branches of the textile, leather, paper, and other industries, and the annual value of the goods in which they are an essential or important part is estimated at 200,000,000*l.*

The opinions of a large number of firms interested in the use or manufacture of aniline dyes are given in the memorandum in question, and emphasis is laid on the fact that the dependence upon German supplies is so great that the present capacity of British dye works is totally inadequate to fill the gap. During the past few weeks the Government scheme has formed the subject of numerous articles and letters to the Press, and a brief review may here be given of these, so far as they deal with the general question of the relationship between science and industry in this country, and ignoring all problems of a political nature, such as the question of the necessity for a protective tariff for the proposed new industry.

Prof. Armstrong, in a letter to the *Morning Post* of February 27, after considering the report of the debate on the Government dye scheme in the House of Commons, concludes that the "situation is an almost hopeless one owing to the lamentable ignorance of our public men of matters scientific." He illustrates this want of knowledge by a criticism of Mr. Runciman's recent pronouncement that in organising the new scheme the Government "had at their elbows two, at least, of the greatest chemists of Europe," a description which, it is contended, will "scarcely pass muster."

If the production of dyes is to be taken in hand seriously, and the foundation laid of a permanent industry, men must be chosen to manage the enterprise who are as able as was my dear old friend, now deceased, Dr. H. Caro, who played so great a part in the development of the Badische Anilin Company, or as his eminent successor, Prof. Bernthsen is, or as is Prof. Duisberg, who has brought the Bayer Company to its present proud position, and now dominates the whole industry. . . . We have in our ranks men of their type who would be immediately available. But apparently the advisers of the Government want subordinate intellects, not leaders.

Dr. M. O. Forster, in a characteristically ironical letter to the same journal, points out that the establishment of an indigenous dye industry "is, has been, and ever will be as much a question of education as of trade. Education of legislators, Government officials, manufacturers, and merchants." It was to have been wished that before taking any steps towards organising the new scheme, every member of the Cabinet, together with the other Ministers, "could have been transferred bodily to Ludwigshafen and personally conducted through the Badische Anilin- und Soda-Fabrik." Dr. Forster depicts with considerable humour the astonishment that Mr. Runciman and the others might have expressed at the organisation and laboratories of this firm, and especially on finding some actual chemists on the directorate.

Several columns are devoted by the *Financier* of February 12, 23, and March 12 to interviews with Mr. W. P. Dreaper, who, as chemist to the Silk Association, speaks with some authority on the practical side of the question. Mr. Dreaper also most strongly emphasises the necessity that the board of the proposed company should contain a scientific representation, and the absolute importance of securing the best scientific knowledge which is available. He protests against the policy of training chemists of the "second class," of which Mr. Runciman seems to consider that we have an insufficient supply, and against the general lack of understanding which exists amongst manufacturers as to what a chemist is "owing to the demand that has sprung up in certain directions for the *7ol.* per annum variety."

The lack of appreciation in this country of the services of the chemist and the absolute ignorance on the part of the Government of what remuneration should be given him is admirably illustrated by the letter of Sir William Tilden in the *Chemical News* of February 26, protesting against the salary offered by the Royal Arsenal, Woolwich, to assistant chemists in the inspection department. At a time when the nation is spending 1,250,000*l.*, and will soon be spending 1,750,000*l.*, per diem on maintaining our army in the field, the utmost that the War Office can afford to give a chemist who has "had a thorough training in inorganic and organic chemistry," and is "a university graduate or member of the Institute of Chemistry," is the sum of *2l. 0s. 6d.* per week! Such an advertisement "gives one to think," and is, indeed, a striking object lesson of the fact which Prof. Armstrong deplores—"we have had no public use for science in our country, and we are blind to our needs and as to our opportunities."

The whole question of the utilisation of science in industry is indeed closely wrapped up with that of the miserably insufficient remuneration given in the majority of cases to science and scientific workers, which Sir Ronald Ross has so strongly emphasised in recent numbers of *Science Progress*. So long as the prospects of the young chemist and the remuneration that he receives are of the order indicated in the above advertisement there is little hope of developing in this country industries that require the services of large numbers of highly-trained scientific workers.

It is interesting to find a politician like Mr. L. G. Chiozza Money, M.P., emphasising the

same lesson in an article in the March *Fortnightly Review* on "The War and British Industry." Mr. Money comments that "we have been content to leave the development of many old industries and the establishment of many new industries to foreign hands," owing to our "normal" disregard of science.

> Let us not deceive ourselves into believing that "science" or "chemistry" affects a limited number of subsidiary industries. There is no industry in the world, from building construction to coke-making, from artillery construction to the making of explosives, from dyeing to leather tanning . . . which has not been in recent years turned inside out by science and invention. We have been content in too many matters to let the world go by us.

Even in the matter of preparation for war Mr. Money, quoting from the address delivered before the Mathematical Association on January 9 by Sir George Greenhill (see NATURE, January 21, p. 573), gives a melancholy contrast between the conditions under which German and British artillery officers have been trained in their science at the Military Technical Academy of Berlin and at Woolwich.

The neglect of science in industry and in public affairs, which is characteristic of this country, culminated in the prospectus of British Dyes (Limited), on the board of which science is entirely unrepresented. The opinions of Sir Henry Roscoe and Sir William Ramsay on the scheme, expressed in the columns of the *Times*, have already been given in NATURE (March 11, p. 41), whilst Prof. Armstrong, in the *Morning Post* (March 13), considers that "our fate as makers of dyes is sealed." The failure of the scheme to attract sufficient capital from investors to justify the directors of the company in proceeding to allotment was referred to last week (p. 94). A meeting of representatives of the textile and dyeing trades was held at Manchester on March 24 to consider the position, and a resolution was adopted in favour of proceeding with the company if certain modifications were made in the business part of the programme. There is no doubt as to the national necessity for such work as the Government scheme is intended to promote, but to expect that a company without a single industrial chemist upon its board of directors will be able to compete with the highly organised coal-tar colour industry of Germany is to show complete want of understanding of the scientific problems which must be faced if permanent success is to be assured.

How little Germany fears competition in this field in the future from English manufacturers, even though aided by the resources of the State, can be gathered from an admirable article by Prof. O. N. Witt in the *Chemiker Zeitung* for February 13. In this article are given the real reasons why Germany has been able to outstrip all competition and to secure practically a monopoly, and why the foundations of the industry are so solidly based that the prospects of the British scheme having anything like a permanent success seem altogether illusory. It must be remembered that the German chemical industry (with one or two exceptions) has never received any protection whatever from tariffs. How futile such protection as that afforded by patent laws can be in comparison with the results obtained by the organisation of science in the service of industry is emphasised by a report to Congress, which is reprinted in the *Chemical News* of March 5. In the United States a 30 per cent. duty on some coal-tar dyes for more than thirty years has not produced a real coal-tar dye industry. Germany, on the other hand, has succeeded because she has placed science on a sound business footing, of which the fair remuneration of the scientific worker has been a striking feature. The part played by the German banks, often with men of considerable scientific attainments on their boards, in developing German industry is emphasised by Mr. W. P. Dreaper in an article on Industrial Research in the *Financier* of March 12.

Germany, in short, has succeeded in the past because she deserved to succeed. Not only has she organised scientific effort on the manufacturing side, but she has organised equally effectively her commercial relations with foreign countries. This side of the question, which has played no small part in attaining the final result, is dealt with in the current *Bulletin* of the Société d'Encouragement (vol. cxxii., p. 33), by M. Lindet, who gives as an example an account of the methods adopted by Germany in Rumania.

> The Germans present to the Rumanians objects specially manufactured to satisfy the local requirements, sold at a price which is lower than ours because they are manufactured more cheaply and because they bear lower charges for transport. The German and Austrian merchants and manufacturers interested in Rumanian business have formed a syndicate with its representative at Bucharest. They obtain in this way facilities for transport in common which we do not possess. They have at Bucharest banks which allow long-date credits, and they have representatives and travellers who without intermission pursue their clients. They advertise widely, and have inaugurated at Bucharest a museum of their goods.

It is an organisation of this kind, highly developed on both the manufacturing and commercial sides that we have to prepare to face in the future, after the war has ended and Germany is left free to resume her usual activities.

DR. A. S. LEA, F.R.S.

THE ranks of those who took part in founding the Cambridge Physiology School grows thin. But a few months ago we recorded the death of Dr. Gaskell. We have now to record the death, on March 23, of Dr. Arthur Sheridan Lea at sixty-one years of age.

Lea entered Trinity College, Cambridge, in 1872, he became Foundation Scholar of the College, and in 1875 he took a First Class in the

Natural Sciences Tripos. His bias was to the chemical side of physiological problems, and, in consequence, on Foster's advice, he began research with Kühne at Heidelberg. Kühne combined in a rather unusual manner the study of physiological chemistry with that of histology, and Lea's work with him developed, as it chanced, mainly on histological lines. Kühne and Lea were the first to observe satisfactorily with the microscope the changes taking place in a living gland—the pancreas—with intact circulation, and to note the special vascular supply of the Islets of Langerhans. One of the figures illustrating their paper is given to this day in most text-books of histology and physiology.

Lea, after his return to Cambridge, specialised in physiological chemistry though he gave instruction to pupils in the whole range of physiology, and to him was due the development in the Cambridge laboratory of advanced teaching in this subject. In the successive editions of Foster's "Text-book of Physiology," Lea wrote the part dealing with physiological chemistry, and in the fifth edition (1892) this part, revised and enlarged, appeared as a separate volume entitled "The Chemical Basis of the Animal Body." His research work was chiefly on the chemical changes in food during digestion, and on the action of rennet and fibrin ferments.

Lea's first post was that of demonstrator of physiology for Dr. Foster. In 1881 he became director of medical studies and assistant lecturer at Gonville and Caius College. In 1885 he was elected fellow of the college, and soon after became bursar. He was appointed university lecturer in 1884. His career in the university and in science was cut short by the development of a spinal disease—signs of which had long been present—making walking at first difficult and later impossible. None of his friends can forget the astonishing fortitude with which Lea met this shattering of his chief interests. He had always led an active outdoor life; he had cruised about the coasts in a yacht whenever opportunity offered; he was Captain in the Cambridge Volunteers, had taken special courses of instruction at Aldershot, and was a good rifle shot. Since he could no longer carry on these pursuits, nor continue his research in the laboratory, he decided after a time to break entirely with the old life. He left Cambridge and settled at Sidcup in Kent.

Rarely then or later did Lea rail at fate. He put on a cheerful countenance, and made the best of what was left him. He kept in touch with his old friends, revised the proofs of their books as occasion offered, and occasionally made small pieces of apparatus for them with the mechanically-driven lathe which served to keep up the cunning of his hands. Before leaving Cambridge he had married, and had one son. In a letter written shortly before he died, Lea expressed pleasure that his son had volunteered for the Army and was serving in the trenches. In this as in other matters he kept his private anxieties to himself. J. N. L.

PROF. A. A. W. HUBRECHT.

THE death of Prof. Hubrecht at his residence in Utrecht on March 21, in his sixty-fifth year, removes another link between the zoology of the present day and the zoology of what may be called the great epoch of Huxley and Balfour. His earlier work dates back to 1874, and was of an anatomical character; it was only in the later part of his career that he devoted himself to embryology, and advocated views which led to lively controversy, and were provocative of good work, both on his own part and on the part of those who opposed him.

Speaking broadly, Hubrecht's name will survive as associated with thoroughly sound work and with the elucidation of a large number of most important new facts, even if the deductions which he drew from them no longer find favour with zoologists. So far, indeed, as theories are concerned, Hubrecht's mind continued to reflect the mental attitude of the zoological world in which his youth was passed; it was, indeed, a time of the "faith that moves mountains." Ardent naturalists were applying the Darwinian doctrine of evolution to every part of the animal kingdom; with the enthusiasm of pioneers they were tackling the most obscure and difficult problems of the natural relationships of animals; the deep abysses which separate different phyla of the animal kingdom were traversed by their soaring imagination, for were not the powers of variation limitless? and did not the principle of "change of function" enunciated by Dohrn authorise one to homologise any organ of any animal with any organ of any other animal to which it bore the slightest resemblance? So Hubrecht, to whom we owe the first thoroughly satisfactory account of the anatomy of the Nemertine worms, was convinced that Vertebrata were descended from a Nemertine worm, and that the Nemertine proboscis represented the Vertebrate notochord.

In his later years Hubrecht devoted himself principally to mammalian embryology, and made a series of most valuable observations on the relations between placenta and young in the eutherian mammals. He was led by these observations to a theory of the origin of mammalia, which has not been borne out by the work of other embryologists or by palæontologists. He supposed that the higher mammalia were directly descended from amphibia, and that the monotremata, the anatomy and embryology of which betrays in an unmistakable manner their reptilian affinities, were secondarily modified forms. Here, again, Hubrecht's firm faith carried him over all difficulties. These remarks are not intended as any disparagement of the methods of comparative anatomy or embryology, but are merely designed to emphasise the fact that in these, as in all other sciences, sound inductions are only possible on the basis of an immense accumulation of facts. Modern zoologists addicted to Mendelism would do well to remember that "of making many factors there is no end, and formulæ are a weariness to the flesh."

Hubrecht was a firm friend of England and a constant visitor at scientific meetings here; he could speak English like a native, and his death will be felt as a personal loss by a large circle of friends in this country. E. W. M.

NOTES.

THE following resolution of the council of the Royal Geographical Society has been accepted by the fellows of the Society: "The council, having become aware that Sir Sven Hedin, K.C.I.E., a subject of a neutral State, has identified himself with the King's enemies by his actions and published statements, orders that his name be removed from the list of honorary corresponding members of the society." Dr. Sven Hedin has also been excluded from the Russian Imperial Geographical Society.

THE council of the Royal Geographical Society has made the following awards of medals and other prizes to be presented at the anniversary meeting on May 17: Founder's Medal to Sir Douglas Mawson for his conduct of the Australian Antarctic Expedition of 1911–14; Patron's Medal to Dr. Filippo de Filippi for his expedition to the Karakoram and Eastern Turkestan in 1913–14; Victoria Research Medal to Dr. Hugh Robert Mill for geographical research extending over many years; Murchison Award to Captain J. K. Davis, who commanded the S.Y. *Aurora* during the time of the Australian Antarctic Expedition; Back Grant to Mr. C. W. Hobley for his contributions to the geology and ethnology of British East Africa; Cuthbert Peek Grant to Mr. A. Grant Ogilvie for his work in geographical investigation and research; Gill Memorial to Colonel Hon. C. G. Bruce for explorations in the Himalayas.

THE annual general meeting of the Chemical Society was held at Burlington House on Thursday, March 25. The Longstaff medal for 1915 was presented to Dr. M. O. Forster, and the retiring president, Prof. W. H. Perkin, then delivered his presidential address on "The position of the organic chemical industry," an abstract of which appears elsewhere in this issue. A vote of thanks to the president was proposed by Prof. H. E. Armstrong and seconded by Sir William Tilden. The new officers and members of council elected were:—*President*, Dr. Alexander Scott; *Vice-Presidents*, Prof. F. R. Japp and Prof. R. Threlfall; *Treasurer*, Dr. M. O. Forster; *Ordinary Members of Council*, Mr. D. L. Chapman, Prof. F. G. Donnan, Mr. W. Macnab, and Dr. J. F. Thorpe.

THE sixty-eighth annual meeting of the Palæontographical Society was held in the rooms of the Geological Society, Burlington House, on March 26, Dr. Henry Woodward, president, in the chair. The report stated that most of the authors for whom space had been reserved in the annual volume, had failed to contribute owing to the circumstances of the war, and an instalment only of Mr. F. W. Harmer's "Monograph of Pliocene Mollusca" would form the issue for 1914. Messrs. John Hopkinson, Clement Reid, S. Hazzledine Warren, and Henry Woods were elected new members of council. Dr. Henry Woodward was re-elected president, and Mr. R. S. Herries and Dr. A. Smith Woodward were re-elected treasurer and secretary respectively.

THE seventieth annual general meeting of the Ray Society was held on March 25, the president, Prof. McIntosh, in the chair. The report for 1914 stated that the number of members had increased and the finances were satisfactory, but a diminution of income was to be expected this year owing to the loss of German and Austrian subscribers on account of the war. For 1914 the "British Marine Annelids," vol. iii., part 1, by the president, had been issued, and for 1915 two volumes were in preparation: the "British Fresh-water Rhizopoda," vol. iii., containing the filose Conchulina, by G. H. Wailes, and the "Principles of Vegetable Teratology," vol. i., containing non-vascular plants and the root, stem, and leaves of vascular plants, by W. C. Worsdell. Prof. W. C. McIntosh was re-elected president, Dr. F. Du Cane Godman treasurer, and Mr. John Hopkinson secretary.

WE notice with regret the announcement of the death on March 27 of Mr. J. J. Beringer, associate of the Royal School of Mines, and principal of the School of Metalliferous Mining, Camborne, Cornwall.

THE death is announced of Prof. F. A. Sherman, professor of mathematics at Dartmouth College, New Hampshire, from 1871 until his retirement as professor emeritus in 1911. Prof. Sherman died on February 25 in his seventy-fourth year.

WE learn from *Science* that the Rockefeller Institute for Medical Research has made a grant of 4000*l.* to be used under the institute's direction to further medical research work under war conditions, and is equipping Dr. Carrel's new hospital in France with apparatus for research work in pathology, bacteriology, and surgery.

THE death is announced, in his seventy-seventh year, of the Rev. Dr. S. J. Coffin, professor of astronomy since 1873 at Lafayette College, Pennsylvania, in which institution he also occupied the chair of mathematics from 1876 to 1886. He was the author of a treatise on conic sections, and had revised "The Winds of the Globe," by his father, Prof. J. H. Coffin.

THE *Times* correspondent at Ottawa states that in the Canadian House of Commons on March 27 Mr. Hazen, Minister of Marine, expressed the opinion that Mr. Stefansson, the Canadian explorer, had been lost with his two companions. The Government, he said, is doing everything of a practicable nature to find the missing men, and three steamers now in the Arctic will set out to the rescue of the expedition as soon as the ice breaks up in the spring.

THE American Association of Immunologists will hold its annual meeting at Washington on May 10 next, under the presidency of Dr. G. B. Webb, of Colorado Springs. The association was founded in 1913 for the purpose of bringing together the medical men of the United States and Canada who are engaged in the scientific study of immunity and bacterial therapy; to study the problems of immunology; and to promote scientific research in this department; to spread a correct knowledge of vaccine therapy and immunology among general medical practitioners.

THE Board of Agriculture and Fisheries announces that with a view of obtaining further information on their growth, migrations, and general life-history, a number of salmon and sea trout have been marked by means of a ring or wire, with or without a label or tag attached. Rewards will be paid for all such marks returned to the Board, with or without the fish, with information as to the date, time, place, and method of capture. When the entire fish is not sent full particulars of its weight, length, sex, and condition should also be given, and a portion of the skin or flesh of the fish to which the mark is fixed should be cut out. Postage and carriage need not be prepaid, and parcels and letters should be addressed to the Board at 43 Parliament Street, London, S.W.

PROF. H. ROBINSON, who occupied the chair of civil engineering at King's College, London, from 1880 to 1902, died on March 24, at seventy-eight years of age. From a short obituary notice in the *Times* we learn that Prof. Robinson had charge of many important works, including railways, water supply, sewerage, and electric lighting, an example of the latter being the successful installation at St. Pancras. He engineered the first public hydraulic power scheme in this country at Hull, and took an active part in promoting the distribution of energy in other towns by hydraulic power, compressed air, and electricity. Prof. Robinson was a fellow of King's College, of the Surveyors' Institution, and of the Sanitary Institute, and a past-president of the Society of Engineers.

WE notice with much regret the announcement of the death, on March 23, at fifty-three years of age, of Dr. S. G. Rawson, principal of the Battersea Polytechnic, London. Dr. Rawson was educated at Charterhouse School, the Royal College of Science, University College, London, and University College, Liverpool. He afterwards became lecturer in chemistry at University College, Liverpool, and in 1895 he was appointed principal of the Technical College, Huddersfield. In 1903 he was appointed director of education to the Worcestershire County Council, and in September, 1907, he became principal of the Battersea Polytechnic. Dr. Rawson was a doctor of science of the University of London, an associate of the Royal College of Science, fellow of the Institute of Chemistry and of the Chemical Society, and, since January, 1914, was chairman of the council of the Association of Technical Institutions.

WE regret to announce the death of Mr. James Kearney, who for the last thirteen years has been inspector in charge of the photo-engraving section of the Egyptian Survey Department. He was originally in the Royal Engineers, and accompanied Sir G. Graham's expeditionary force to the Sudan in 1885 as photographic expert. He was then for several years attached to the Solar Physics Committee at South Kensington, and will be remembered by many old students of the Royal College of Science, London. In 1893 he went to West Africa with the British Eclipse Expedition as expert photographer, and again in 1906 he was with the party who observed the solar eclipse at Aswan. During this period he several times received the thanks of the Royal Society. From 1893 to 1902 he was one of the instructors at the School of Military Engineering at Chatham, which he left to go to Egypt. His wide experience of his subject and originality have largely influenced the development of the reproduction of maps by the Egyptian Survey Department, and practically all their maps now are reproduced by the photo-metal process.

THE following are among the arrangements for lectures at the Royal Institution after Easter:—"The Animal Spirits," Prof. C. S. Sherrington; "Advances in the Study of Radio-active Bodies," Prof. F. Soddy; "The Evolution of Steel: Influence on Civilisation," Prof. J. O. Arnold; "The System of the Stars: (1) Star Colour and its Significance; (2) The Stellar System in Motion," Prof. A. S. Eddington; Advances in General Physics," Dr. A. W. Porter; "The Movements and Activities of Plants," Prof. V. H. Blackman; "Method of Presenting Character in Biography and Fiction," Wilfrid Ward; "Modern Artillery," Lieut.-Col. A. G. Hadcock; "Photo-electricity" (the Tyndall Lectures), Prof. J. A. Fleming; "Colouring Matters of the Organic World: (1) Colouring Matters of Nature; (2) Dyes, the Creation of the Chemist," Dr. M. O. Forster. The Friday evening discourses will begin on April 16. Mr. Stephen Graham will deal with "The Russian Idea" and Major P. S. Lelean with "Military Hygiene at the War"; they will be followed by Canon Pearce, Sir John Jackson, Sir Ernest Rutherford, Dr. H. Walford Davies, Profs. F. G. Donnan and O. W. Richardson, and Mr. Edward Heron-Allen.

IT is an axiom in business that to be successful the merchant must provide what the public wants. He may try to educate the public by advertisement and other means, but it is the public demand alone that regulates the quality of the supply. The population of this country demands a white loaf of light texture made from the finest portion of the wheat berry, and bakers and millers have made it their business to supply this want. Even at the height of the standard bread boom it is stated that the demand for this article did not reach 5 per cent. of the total. Whether the public taste is the most satisfactory on scientific grounds is possibly open to question; the subject was discussed in an article in these columns on January 7. In the opinion of nearly everyone qualified to judge, our bread is good enough in quality, and the fact remains that the public will take no other. The Bread and Food Reform League holds the contrary view, and recently presented a memorial to the President of the Local Government Board. The *Times* of March 26 reports the presentation of this memorial under the heading, "A Notable Protest." The list of signatories contains a number of notable names, but those of experts who can speak with authority upon the subject are not prominent, which is typical of the national attitude towards scientific knowledge. Mr. Samuel expressed the opinion that it is impracticable to undertake at the present time legislation on the lines suggested by the memorial.

WE regret to record the death of Lady Huggins, at Chelsea, on March 24, after a long illness. From the time of their marriage in 1875, Lady Huggins was

the able and unwearying assistant of her distinguished husband, the late Sir William Huggins, and was definitely associated with him as joint author of numerous original papers on astrophysical subjects. Among the investigations in which she took special part were those relating to the spectrum of the great nebula in Orion, the photographic spectra of Uranus and Saturn, absorption bands in the spectrum of Mars, the spectrum of Nova Aurigæ, and the spectra of Wolf-Rayet stars. In laboratory work she collaborated in investigations of the effect of density on the intensities of the H and K lines of calcium, of the modifications of the magnesium line 4481 under different experimental conditions of the spark discharge, and in photographic studies of the spectrum of the spontaneous luminous radiation of radium. Lady Huggins was also joint author of the well-known "Atlas of Representative Stellar Spectra" (1899), which includes the later work of the Tulse Hill Observatory, and a general discussion of the problem of stellar evolution; initial letters and other drawings by Lady Huggins add much to the beauty and interest of this volume. She also acted as joint editor of "The Scientific Papers of Sir William Huggins," published in 1909. In recognition of her valuable services to astrophysics, Lady Huggins was elected an honorary member of the Royal Astronomical Society in 1903.

THE death is announced, after a short but painful illness, of Prof. Eberhard Fraas, curator of the geological section of the Royal Natural History Museum, Stuttgart. Prof. Fraas, who was born in 1862, was the son of Prof. Oscar F. von Fraas, whom he succeeded in the curatorship at Stuttgart in 1897. He was a student of Prof. Karl A. von Zittel, of Munich, and devoted his special attention to vertebrate palæontology. His first important work was a memoir on the Labyrinthodonts of the Swabian Trias, published in the *Palaeontographica* in 1889. This was followed in 1891 by a separate volume on the Ichthyosauria from the Jurassic of Würtemberg. In 1894 he first announced Mr. B. Hauff's remarkable discovery of the integument and fins of Ichthyosaurus, and during following years he described several fossil fishes and reptiles obtained by Mr. Hauff from the Upper Lias of Holzmaden. As a curator of the Royal Museum, Prof. Fraas made a special effort to collect systematically the fossil reptiles from the quarries in the Triassic sandstones round Stuttgart, and met with great success. He not only discovered unusually fine examples of Dinosaurians and Crocodilians of known species, but also obtained several new skeletons throwing light on the ancestry of the Chelonians. Most of this collection still awaits detailed description. Prof. Fraas also interested wealthy friends in the Tertiary mammalia of Egypt, and among the specimens obtained was the skull of the most primitive known whale, which he described in 1904 under the name of *Protocetus atavus*. He showed that this skull was intermediate between that of ordinary early toothed whales and that of the early land carnivores (Creodonta). In 1907 ill-health caused him to visit German East Africa, and while there he discovered the first remains of the gigantic Cretaceous dinosaurs, which have subsequently proved to exceed in size even the largest of the dinosaurs known from North America. Prof. Fraas's excellent scientific work will remain as a permanent memorial of his acumen and industry.

THE large Australian collections of stone implements are little known to ethnographers. During the recent visit of the British Association, Miss A. C. Breton carefully examined the local museums, and in *Man* for March she gives an account of them. The finest collection, that at Melbourne, has been carefully arranged by Messrs. A. S. Kenyon and D. J. Mahony, who will, it may be hoped, publish an account of it. Their researches tend to show that, as in other countries, the *coup de poign*, once invented, was never forgotten. As other forms became known, all continued in use together until something more serviceable was introduced.

THE question has often been asked: Was there an earlier race in occupation of the area in Africa at present held by the Bantus? In *Man* for March Mr. W. H. Beech reports that in the Kikuyu country some ancient pottery has been found, said to be the work of a people called Gumba, who displaced the Maithoachiana, cannibal dwarfs. These Miathoachiana are now believed to be earth-gnomes, skilled in the art of iron-working. Mr. Beech, with some amount of plausibility, suggests that they were possibly Bushmen, Pygmies, or both, and that they were a local indigenous race of the Stone age, who used the flint implements often found in the Kikuyu country. The Gumba are said to have made pottery and to have taught the Kikuyu the art of smelting. They may have been pre-Bantu Hamite invaders; but of this there is no evidence, and the legend may tend to show that the first discovery of iron was made in Africa.

Irish Gardening for March, 1915, contains several useful horticultural papers. One on the different species of Hamamelis, or witch hazel, hardy in the British Isles, is appropriate as these interesting shrubs from China and Virginia are so valuable in the garden in full flower in mid-winter. *Hamamelis mollis*, from China, with its fragrant flowers, is the most beautiful species. *H. virginiana*, from eastern North America, was introduced so long ago as 1736, and is further of interest since witch hazel snow or hazelene snow is prepared from an extract of the bark.

THE annual note on the ornamental waterfowl at Kew is always of interest, since so many species breed there in captivity. In 1914 the following birds were reared:—Carolinas; mandarins; common, red-crested, white-eye pochards, and tufted ducks; common sheldrake; Brazilian, common, and Chilian teal; bar-headed, white-fronted, and other geese; and a black-necked swan. Several geese having been destroyed by a badger which took up its abode in the gardens it was decided to dig him out and deport him. When digging him out, his earth was found to be carpeted with bluebell leaves and flowers, and many shovelsful were thrown out.

THE *Kew Bulletin* (No. I., 1915) contains an account of additions to the gardens, museums, library, and herbarium during the past year. Among many interesting presentations to the gardens the most valuable was the fine collection of botanical orchids presented by Lady Lawrence. Collections of filmy ferns in excellent condition have also been received from the Director of Agriculture, Jamaica, Dr. L. Cockayne, New Zealand, and the Assistant-Director of Agriculture, Trinidad. The herbarium has acquired no fewer than 25,500 specimens as donations or exchanges, and 13,500 by purchase. Among the former, Mr. Crossland's collection of British fungi, with drawings, presented by the Bentham Trustees, is one of the most important additions. The Bentham Trustees have also enriched the library with several rare books, and Miss Willmott has presented a copy of her fine work on "The Genus Rosa."

THE Canadian Department of Mines has published a Memoir (No. 20-E) upon the goldfields of Nova Scotia by Mr. W. Malcolm. This forms a large volume of some 330 pages, and gives a detailed description of the various gold-producing areas, which together include about one-half of the entire province of Nova Scotia. These descriptions are mainly of local interest, but a good deal will be found of importance to the student of ore deposits, owing to the fact that these particular deposits present a number of specially interesting features. The report shows clearly that the veins belong mainly to the type known as bedded veins—that is to say, mineral veins which are interstratified with, and generally conformable to, the country rocks, though some fissure veins that cross the formations are also met with. To the former class belong the numerous saddle veins, and especially those curious corrugated saddle veins, to which the name of "barrel quartz" is given locally; the peculiar structure of these veins has long attracted the attention of geologists. The memoir has been compiled with great care, the detailed statistics of production being amongst its most welcome features, and it forms a very valuable contribution to our knowledge of these goldfields.

THE wet winter of 1914–15 is dealt with in *Symons's Meteorological Magazine* for March in a preliminary way, it being as yet too early to prepare any complete account of the rainfall. Taking the British Isles as a whole, the four months, November and December, 1914, and January and February, 1915, are said to have been all wet, and of these December and February were, relatively to the average, the wettest. November rainfall was below the average in the south of Ireland and in the south-west of Wales, while December was wet everywhere, especially in the south. More than two and a half times the average fell in the south-east of England, and more than three times the average in Sussex. The rainfall of January was double the average at a few stations in England, again chiefly in the south-east. In February more than twice the average rainfall was recorded in the south of England and Wales, in Yorkshire, and in the south and east of Scotland. The rainfall for the four months was 168 per cent. of the average over England and Wales, 139 per cent. over Scotland, 150 per cent. over Ireland, and over the British Isles as a whole it was 155 per cent. of the average. No previous winter seems to have been so wet. In the Thames Valley the general rainfall for the four months was 19·19 in., which is 205 per cent. of the average, and previous records, which exist for thirty-two years, show no aggregate general rainfall for four months over the Thames Valley so much as double the average.

THE stability relations of the ternary system CaO–Al_2O_3–SiO_2 are studied by Mr. G. A. Rankin in the *American Journal of Science*, vol. xxix (1915), p. 1. Photographs of models, due to the ingenuity of Mr. England, are given; in these, the horizontal positions represent the compositions of the ternary mixtures and the vertical measures give the corresponding melting temperatures. The result has some resemblance to the surface of a mountainous country, the peaks of which represent the melting points of compounds stable at their melting points. The base is an equilateral triangle, the heights above its angles being the respective melting points of the three members of the system, *i.e.* CaO, 2570°; Al_2O_3, 2050°; SiO_2 (cristobalite), 1625° C.

THE Washington Bureau of Standards has carried out a useful investigation of the familiar "basic lead acetate solutions." Mr. R. F. Jackson, in Bulletin No. 232, has given a complete equilibrium diagram for the system $H_2O|PbO|PbC_4H_6O_4$. In addition to the free base, $Pb(OH)_2$, and the neutral acetate, $PbC_4H_6O_4$, two double-compounds may exist in equilibrium with the solution. The most important of these has the formula $PbC_4H_6O_4,2PbO,4H_2O$, but there is a narrow range of compositions within which the compound $3PbC_4H_6O_4,PbO,3H_2O$, is the stable phase.

THE chemical and mechanical relations of iron, cobalt, and carbon formed the subject of a paper read by Prof. J. O. Arnold at the Institution of Mechanical Engineers on March 19. The paper gives account of research work on the influence of cobalt, from which it appears that the tensile strength increases with the percentage of cobalt present. In annealing tests, with 2·68 per cent. of cobalt present, very little of the combined carbon was precipitated as graphite; two-thirds of the combined carbon passed into the graphitic form in specimens containing 5·5 per cent. cobalt, and in specimens having a higher percentage of cobalt, annealing caused the whole of the combined carbon to pass into the graphitic form. Dr. Arnold, in his remarks, pointed out that there were three true steels: (1) the old iron and carbon steel; (2) the true iron and carbon steel with 5 per cent. of vanadium; in this steel carbide of iron ceased to exist, carbide of vanadium is present; (3) iron and carbon steel having 11·5 per cent. of tungsten; the tungsten expels the carbide of iron, giving the true tungsten steel. Iron and carbon steel hardens at 730° C., vanadium steel at a temperature just before the melting point (1450° C.), and in tungsten steel hardening starts at 850° C., and is not completed until nearly 1200° C.

MESSRS. HENRY SOTHERAN AND CO., of 140 Strand, W.C., and 43 Piccadilly, W., have issued in two parts —Nos. 754 and 755—a catalogue of important works in natural history, including zoology, botany, gardening, farming, microscopy, and geology. The library of the late Prof. Howes is included in the collection. Owing to the war, the volumes are being offered at very low prices.

THE reference in NATURE of March 25 (p. 96) to "three Englishmen, namely Sir A. Geikie, Sir William Ramsay, and Lord Rayleigh," who are members of seven national scientific societies, has brought the inevitable letter from a correspondent suggesting injustice to "Scots." In the case of Prussia we used deliberately the phrase "men of science in Prussia," knowing, of course, that Prof. van't Hoff, though he lives in Berlin, is not a Prussian. It would perhaps have been better to have used the word "Britons" instead of Englishmen in the note, or to have said "men of science in England," as the comparative statement holds good only by taking the place of residence of each person.

OUR ASTRONOMICAL COLUMN.

COMET 1915a (MELLISH).—The following is the ephemeris for Mellish's comet for the current week as computed by Messrs. Braae and Fisher-Petersen :—

12*h*. *Berlin Mean Time.*

	R.A. (true) h. m. s.	Decl. (true) ° ′	Mag.
March 31 ...	18 2 51	... −1 23·1	
April 2 ...	5 9	... 1 41·2	... 8·5
,, 4 ...	7 25	... 2 0·5	
,, 6 ...	9 40	... 2 21·1	... 8·3
,, 8 ...	18 11 55	... −2 43·2	

The comet is in the constellation of Serpens, and lies a little to the west of the star Eta. It is approaching both the earth and sun, and it will be nearest the earth in about the middle of June. Unfortunately it will be too far south to be seen from these latitudes, but its increasing brightness will make it a conspicuous object for observers in the southern hemisphere. Elements and ephemeris slightly different from the above appear in the Lick Observatory Bulletin No. 268.

THE NINTH SATELLITE OF JUPITER.—An account of the discovery, observations, and orbit of the ninth satellite of Jupiter is given by Seth B. Nicholson in No. 265 of the Lick Observatory Bulletin. The discovery of this faint object (about 19 mag.) was made with the Crossley reflector at the Lick Observatory on plates taken on July 21 and 22 of last year. A series of photographs was being made to secure positions of the faint satellites of Jupiter, and it was on the first plates taken for the eighth satellite that the new member was found. The plate was so exposed that the photographic image of the eighth satellite should not be elongated, and a similar exposure was made on the following night. A comparison of the two plates indicated the image of an almost circular object on both plates near the eighth satellite. Further photographs on July 23 and 24 corroborated the reality of the images in question, and in consequence the discovery was publicly announced. The present bulletin is accompanied by a plate showing reproductions of the photographs taken on July 22, 23, and 24, indicating the eighth and ninth satellites. Mr. Nicholson next describes the computation of the orbit of the new body by Leuschner's method, and gives the approximate elements calculated by him, together with those of the eighth satellite derived by Crawford and Meyer for comparison. These serve to establish the identity of the object and to describe the nature of its orbit. The motion, like that of the eighth satellite, is retrograde.

	IX. Epoch and Osculation 1914 July 27·8817 G.M.T.		VIII. 1908 March 8·8233 G.M.T.	
M_0	49° 28′		266° 4′	
ω	71 10	1914·0	67 46	1908·0
Ω	309 23		240 2	
i	157 51		144 51	
e	0·1630		0·3520	
μ	0°·3154		0°·4573	
P	3·125 years		2·155 years	
log a	9·3232		9·2156	

RELATIVE PROPER MOTIONS OF THE PLEIADES.—In the *Astronomische Nachrichten* No. 4790 Dr. R. Trümpler gives details of an interesting investigation on the relative proper motions of the Pleiades group. The work is based chiefly on a previous research (1901) by J. Lagrula entitled "Etude sur les occultations d'amas d'etoiles par la lune avec un catalogue normal des Pléiades," in which the differential positions of 102 stars in the Pleiades group in relation to the central star of η Tauri were determined. Dr. Trümpler derives the following conclusions from Lagrula's proper motions of forty-three stars. The relative proper motions of the eleven brightest stars are very small. The relative motions of the fainter stars have larger velocities than the bright stars, and exceed the limit of errors of the determinations. The proper motions of the fainter stars indicate a systematic variation from those of the brighter stars, or, in other words, the system of the fainter stars appears to displace itself with regard to the system of the brightest stars. In the case of the fainter stars there is indicated a movement of rotation in the direction of decreasing position angle, one rotation being of the order of two million years; the brightest stars appear to take either no part or only a very small part in this movement. The point of radiation for the proper motions of the Pleiades cannot be deduced with certainty. It can only be said that from the observed radial velocities of the brightest stars the parallaxes of the Pleiades must be smaller than 0·1″.

REPORT OF THE STONYHURST COLLEGE OBSERVATORY.—The report of the director of the Stonyhurst College Observatory for the year 1914 consists for the main part of the results of the meteorological, magnetical, and seismological observations. Reference to the astronomical work accomplished during the past year is incorporated under the heading, "Report and Notes by the Director." These include, first, the results of the measures of the disc areas of sun-spots as measured from drawings. It is shown that the year 1913 was the minimum year of sun-spot activity, while the year 1912 was the minimum year for the mean range of magnetic declination. These results are in accordance with those published in this column for March 18 (p. 75). An account is also given of the expedition to Hernösand, Sweden, to observe the total solar eclipse of August 21, 1914. Reference is made to the record of the strong red radiation coronal line 6374·3, which is described here as "a strong member of a band or fluting. . . ." The presence of this coronal radiation was first announced by M. Deslandres (*Comptes rendus*, November 16), and was soon corroborated by M. Carrasco by the examination of his own eclipse spectrograms.

RECENT WORK OF THE UNITED STATES GEOLOGICAL SURVEY.

IN No. 82 of the handsome series of Professional Papers published by the United States Geological Survey, Myron L. Fuller describes "The Geology of Long Island, New York." This suburban island, from the lively beach of Coney Island on the west to the old-time refinements of Easthampton, protects the Connecticut coast for more than a hundred miles. Its core consists of sandy strata, which are now recognised as Cretaceous; these appear at the base of the bluffs of the north coast and in wells in the interior. The early events of the Ice age piled the Manhasset Formation across them, and on the somewhat irregular plateau thus built up two great moraines were deposited as records of the Wisconsin epoch of ice-advance. One of these appears conspicuously along the axis of the island, while the younger moraine lies near to the north coast. The sandy plains formed by the outwashed material from these ridges cover a large part of the country. The present memoir, with its two large folding maps, may not appeal to the motorists who denude the roads on Sundays; but it will be prized on the shelves of those cultured citizens who have built their summer homes among the gracious woods and inlets of the sound.

It is a long stretch from the New York shores to the shifting mouths of the Mississippi. E. W. Shaw, in No. 85-B, deals with the mud lumps that attracted Lyell as examples of the seaward growth of land, and concludes that they arise from the creep of semi-fluid clay from beneath the land and the shallows, under the pressure of new alluvium deposited by flooding. Where currents sift the delta-material, leaving sandy banks behind, the resistance to outward flow is sufficient to cause the moving clay to rise up to the surface. Some of the lumps stand 8 ft. above the water. Unless they subside, they are worn away by the sea in a few years. The reader of this paper must remember that a "pass" in the delta is not a passage-way, but a delta-finger dividing one bay from another.

Oklahoma, the paradise of protected Indians, is being explored for oil-pools, and the illustrations in Bulletin 547 introduce us to the broad alluvium-filled valleys of the country, in which the rivers may run almost dry, while sand-dunes (p. 31) may gather near their banks. The conditions remind us of those of Permian times in England. Another interesting view of river-action in easily denuded strata is given in Bulletin 575, where the Grand River, a tributary of the Missouri in South Dakota, is seen meandering on a great plain of level Pierre Shale, leaving outliers of the more resisting Foxford Sandstone, the highest marine Cretaceous deposit, standing out above it. To the west, in Wyoming, the Cretaceous beds, though still frequently horizontal, are associated with mountainous outcrops of contorted Carboniferous rocks, and the rainfall allows of a thick growth of trees across them (Bull. 543, "Lincoln County, Wyoming," by A. R. Schultz). In Professional Paper 78, W. H. Emmons and F. C. Calkins guide us through a high and ice-carved region around Philipsburg in western Montana, which was lifted from the sea with the central Rocky Mountains in earliest Eocene times. Pre-Cambrian rocks here come to light, and it is interesting to note that features of stoping and intimate penetration, resembling those so well seen in Finland, have arisen in them by the intrusion of Cainozoic granodiorite during the general uplift (Fig. 1). A careful description is given of the products of contact-metamorphism and of exhalation from the igneous invaders. The district includes ores of gold and silver, imported by these early Cainozoic intrusive bodies (p. 186). The first mining operations were undertaken twenty-five years before the arrival of the railway, and exploitation has now so far worked away the ores that the small town of Philipsburg may look forward to relying on its agricultural industries. The usual beautifully printed maps accompany this memoir.

Early Eocene granite appears on the west flank of the mountains in Idaho (Bulletin 528, "Geology and Ore Deposits of Lemhi County," by J. B. Umpleby), and it suffered from erosion in Middle Eocene times

FIG. 1.—Stoping and absorption-features at contact of Cainozoic granodiorite and Algonkian sediments, Storm Lake, Montana.

(p. 43). Gold-bearing veins are associated with the rhyolitic lavas that broke out in the area in the Miocene, and possibly the Pliocene period, and this bulletin is largely concerned with mining. The main routes for traffic are eastward; the differences of elevation cause a great variety of climatic conditions in Lemhi County, but the photographs around Salmon City have a distinctly pleasing air. The same author describes a somewhat similar region in Bulletin 539 ("Some Ore Deposits in North-Western Custer County, Idaho"), where the open season lasts from the beginning of May to the end of October, and where tetrahedrite and galena are mined at 8000 ft. and upwards above the sea. A remarkable erosion-surface, developed near base-level in Eocene times, has left traces that are now elevated to 9600 ft., with valley-floors 5000 ft. below them. The mines on Poverty Flat thus stand at 9500 ft., on the margin of a partly wooded plateau covering twenty-five square miles, which has been worn as a peneplane across steeply tilted Palæozoic rocks. As a result of elevation, valleys were developed in the Miocene lacustrine

strata to a depth of more than 4000 ft., prior to their occupation by the post-Pliocene glaciers (p. 17). These figures serve to illustrate the removal of Flysch beds and other Cainozoic strata during Pliocene times from the surface of our European Alps.

B. S. Butler, in Professional Paper 80, reports on the copper and other ores of the San Francisco district in Utah. The mines lie in the arid Great Basin, near the south end of the lost Lake Bonneville. The block-structure of the country is rendered all the more interesting by the continuation of the faulting into recent times. The intrusion of quartz-monzonite in a Cainozoic epoch (p. 70) has produced diopside as a common contact-product in the early Palæozoic limestones, and an example (pl. xii., Fig. A), where this has become altered into serpentine is of interest for comparison with various "eozoonal" rocks.

"The San Franciscan Volcanic Field, Arizona," described by H. H. Robinson (Professional Paper 76), lies three hundred miles farther to the south, beyond the Grand Canyon country, but sufficiently near to allow of a confusion of the mountain names. San Francisco Peak, rising 12,611 ft. above the sea, retains its general form as a great volcano with secondary cones,

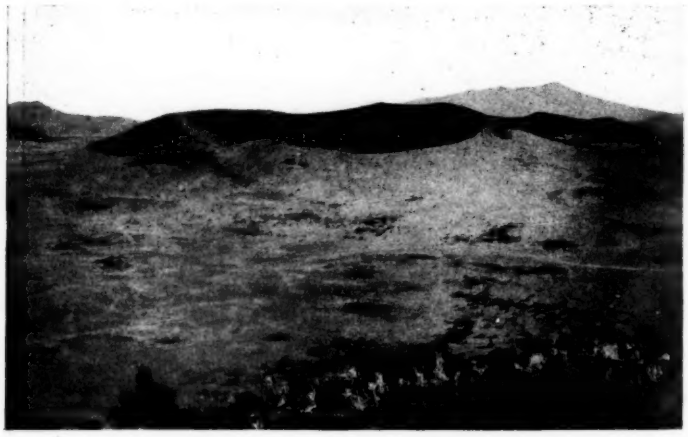

FIG. 2.—Recent cone formed of ash with lava above, north-east edge of the San Francisco volcanic field.

and fine igneous studies can be made in the ravines upon its flanks. It is believed (p. 52) to have originally risen 8800 ft. above the plateau of horizontal Carboniferous rocks, and to have lost 3000 ft. by denudation. This region stood close to sea-level in late Pliocene times, and then became deluged by flows of basalt; elevation by faulting followed, and rhyolites and andesites appeared on the surface as it underwent dissection. The great volcanoes belong to this epoch, at the opening of the Quaternary era. A far greater elevation, amounting to thousands of feet, then took place, introducing "the present or canyon cycle of erosion" (p. 93), and scattered vents emitted basalt and built up lava and scoria cones (see Fig. 2). The railway across the Colorado Plateau, from which a branch runs north to the Grand Canyon, gives access to this volcanic field. The great cone of Bill Williams Mountain, named after a scout killed in Indian warfare, is already ascended by a tourist-track, and in time we may hope that Flagstaff Station will be as famous among geologists as Mont Dore. Visitors will pass on, however, to the canyon country, and L. F. Noble (Bulletin 549) revives our memories of Dutton's survey in the fine illustrations to his work on "The Shinumo Quadrangle." In the region treated there is only one permanent habitation. Plate xviii. shows the geological history of the country, concerning which much has been learnt since Dutton's work, as recorded in a natural section rising a mile above the river. A hill of inclined Algonkian quartzite is seen half-way up, buried by horizontal strata from Cambrian to Upper Carboniferous. H. H. Robinson, the author of the paper on the San Franciscan volcanic field, is cited (p. 91) as providing the most recent summary of the physical history of the canyon country.

Alaska, which is being explored so conscientiously, is represented by nine bulletins published in 1913 and 1914. While these are mostly concerned with mining prospects, glacialists will appreciate the evidence of the forward movement of ice across forests in Bulletin 526, and of the formation of "push moraines" 25 ft. high, where a glacier-nose impinges upon beach-deposits. Though boulder-clays are rarely specifically mentioned, it is clear that a large part of the Alaskan "moraine" material is of this character. In Bulletin 534, for instance (p. 43), on the Yentna district, we read that "deposits of glacial till of the ground moraine type are widespread," up to 75 ft. in thickness, with particularly abundant striated pebbles and boulders.

Among publications dealing with minerals, we may note the illustrated descriptions of Ferberite, or wolfram free from manganese, by F. L. Hess and W. T. Schaller, in Bulletin 583. The latter author investigates the crystallography of the species. Alunite attracts attention in Bulletin 540 ("Contributions to Economic Geology, 1912," published in 1914, p. 347). Numerous saline deposits have been prospected without results for potash salts on a commercial scale (p. 406). The phosphatic shales at the top of the Carboniferous beds in Idaho, and probably of Permian age, are described in Bulletin 577. No. 585 consists of a list, with localities, of all the useful minerals and rocks of the United States, arranged under the States in which they occur. H. S. Gale refers the calcium borate, Colemanite, of southern California to the emission of boric acid from basaltic lavas into travertine deposits of Miocene age (Professional Paper 85-A, p. 8). G. A. J. C.

THE POSITION OF THE ORGANIC CHEMICAL INDUSTRY.[1]

THE value of the colouring matters consumed in the United Kingdom is 2,000,000*l.* per annum, and these dyes are essential to textile industries, representing at least 200,000,000*l.* a year, and employing 1,500,000 workers, and to many other industries, such as the wall-paper, printing, and paint industries, requiring lakes and pigments. In recent years Germany has supplied this country with nearly all these dyes, with organic chemicals required for photographic purposes, with the natural and artificial products used in the manufacture of scents and perfumes, with synthetic and other drugs and disinfectants, and

[1] Abstract of the presidential address delivered before the Chemical Society on March 25 by Prof. W. H. Perkin, F.R.S.

with nearly all the fine chemicals. As a result of allowing these trades to pass so much out of our hands, we are faced with the position that stocks are rapidly diminishing and prices are rising to such an extent as seriously to hamper many of our industries.

The great dyeing industry has been lost to this country because we, as a nation, and our manufacturers in particular have failed to understand the extreme complexity of the scientific basis of organic chemical industry. Science has been neglected in the works, and the chemists trained in organic chemistry necessary to carry on the industry in successful competition with Germany were not to be found in our universities. In 1870, the time when this industry commenced to be transferred to Germany, organic chemistry was not recognised by our older universities, and the newer universities, which since then have done so much for the progress of science, did not exist.

Many of our universities, and particularly those of Oxford and Cambridge and those in Scotland, contributed practically nothing to the advancement of organic chemistry in the latter part of last century, and even now their output of research is far less than it should be; while in Germany, as soon as the importance of the subject became apparent, schools especially devoted to the subject were founded by such great teachers as Liebig, Wöhler, Kekulé, and Baeyer. Every effort was made by the establishment of laboratories, aided by the State, to help forward the new movement, and the step which assisted more than anything else was the provision that in every German university, research must be an essential part in the training of every student of chemistry, who, in order to obtain his degree of Ph.D., spends at least one and generally two years in research; whilst in this country, students obtain their B.Sc. honours degree after a course of three years' study, and the majority are under no obligation to do any original research during their university career.

The recognition of the necessity for research forming an essential part of the training of the student in science has been responsible for the large output of original work in Germany as compared with this country. The B.Sc. degree, and certainly the B.Sc. honours, should not be conferred except on those who have undergone a course of research work, and the necessity for a change in this direction is now being recognised, though the proportion of graduates who engage in research in these circumstances is small compared with the number of Germans who qualify for the Ph.D. degree. Had there been a supply of first-rate chemists at the disposal of the manufacturers of this country there can be no doubt that such industries as the aniline dye industry and the coal tar industry would still be in existence and flourishing here.

Germany has recognised the value of the closest possible contact between the industries and universities, and the majority of the professors and privatdocenten keep in touch with the large factories. Appreciation by the manufacturers of the value of science in connection with industry is one of the reasons for the development of the German chemical works. To obtain a share of the wealth and prosperity opened by this vast industry, our manufacturer must so conduct his works that research is going on unceasingly; his laboratories must be properly equipped and staffed by research chemists of ability, with a scientific leader to direct the work; for the first essential for the success of a chemical works is for it to be under chemical control, and every department must be in the hands of an expert. Recognition of the soundness of this principle is one of the main reasons for the success of the works in Germany, where all the principal dye works are under chemical control; chemists are the heads of departments, and are included in a large proportion on the board of management.

In order to deal with the problem of the shortage of dyes in this country, schemes have been proposed by the Government to ascertain the best means of obtaining sufficient supplies of chemical products. The first scheme recommended by the special committee appointed by the Government was not cordially received, and in explanation of this it should be pointed out that the committee consisted entirely of business men. Had a chemical expert been present, such a scheme would not have been placed before the public. In the memorandum of agreement it is stated that the company has been incorporated for the purpose, amongst other things, of manufacturing and selling dyes, colours, and other chemical substances which, previous to the war, were exclusively or principally manufactured in Germany, and no mention is made of the main object of such a company—namely, the employment of a large staff of research chemists under leaders of ability for the purpose of making discoveries in every possible direction.

It is not merely a question of producing the dyes that are required during the war; the company must be able to compete successfully with the German industries after the war. No greater mistake could be made than to think that in order to manufacture a dye it is only necessary to follow the directions given in the patent, for the patent is so worded that while it satisfies the requirements of the patent laws of the countries in which it is taken out, it gives as little information as possible, and contains no indication of the process used in the actual manufacture. In the first place the methods of manufacture and the utilisation of by-products must be worked out until they have arrived at the same state of efficiency as in Germany. Another point to be borne in mind is that the Germans supply dyes to practically all the other nations, and could well afford to sell dyes at a loss to themselves in this country until the English company had been ruined. And what will happen after the war with regard to using German patents? Will these patents again become the sole property of the Germans and be workable in this country only on the payment of royalties or licenses?

The application for shares in the proposed company was unsatisfactory. The Government withdrew the first scheme and substituted an amended proposal which is a proof of a desire to meet in a generous spirit the criticisms raised against the first scheme. The grant of 100,000*l.* which the Government proposed to make to the company for research purposes would be better employed in subsidising the research laboratories of those universities and colleges willing to specialise in organic chemistry and to train a certain number of students with a view of their entering the service of the company.

The existing dye works in this country compare very unfavourably with those in Germany, where experience has been in favour of building large works and against spreading manufacturing operations over small works situated in different parts of the country. Moreover, in the manufacture of any substance by-products result, which must either be recovered or used in the manufacture of other saleable products, and in order that these by-products may be used to the best advantage, the dove-tailing operations should be carried out on the same site, and thus save transporting the by-products from one works to another, an operation that must entail loss. The proposal of the Government, therefore, to take over the existing works in this country appears a doubtful policy.

The German works with which the new British

company must compete are enormous organisations controlling almost unlimited resources, and if after the war these organisations continue to work with the same efficiency as before, some years must elapse before we could compete successfully with them. Failure to develop on research lines is scarcely conceivable if the works are in the hands of a highly trained chemical staff; but if the new industries get into the power of the business man who wants an immediate return for his outlay and fails to appreciate the vital importance of scientific control, then no protection by a tariff on the import of German dyes and other organic products can avert disaster.

THE CO-OPERATION OF SCIENCE AND INDUSTRY.

A DISCUSSION upon the above subject took place at a conference held under the auspices of the Institute of Industry and Science at the Mansion House on March 25. The chairman, Mr. Frank Warner (president of the Silk Association), in opening the proceedings, dealt with the crying need for a greater application of science to industrial problems and for the need of the organisation of industry. The two main objects of the Institute of Industry and Science he defined as the organisation of capital for industrial purposes, and the bringing about of those working conditions in which science and industry are in closer contact.

Mr. Taylor Peddie, chairman of the Institute, stated that the Institute aimed at embracing within its membership the trade organisations of the country, and that already much progress had been made in this direction and with the formation of a trade bank. Prominent men of science had joined the court of directors of the Institute, and by development of this scheme it was hoped to bring science into intimate contact with industry. Mr. Peddie then opened the discussion by reading a paper upon "The Influence of Science upon Political Economy," in the course of which he demonstrated from comparative statistics the large reductions in the cost of production that had been brought about by the application of science to processes of manufacture.

Sir Philip Magnus stated that the output of research work from the English universities was equal to that of Germany, and that their graduates were as capable and as well trained as those from the German universities; but that, owing to our lack of appreciation of science, we made practically no use of our research work, nor of our trained men. He felt that any movement trying to bring about a more marked sympathy between science and industry was worthy of the greatest support.

The Earl of Portsmouth, in moving a resolution to the effect that the meeting supported the organisation of capital for industrial purposes, and that it agreed that a closer co-operation of science and industry was essential, stated that he was of opinion that in the near future the people now drawing their income from land and property would by force of circumstances be compelled to turn their attention to industrial affairs.

The Hon. F. Mackenzie (Agent-General for New Zealand), in seconding the resolution, expressed the opinion that we were too prosperous in this country to appreciate the need for organisation. He stated that twenty-five years ago agriculture in New Zealand was at a very low ebb, farmers were selling sheep at the rate of 18*s.* 9*d.* a gross, butter was 4*d.* a lb., but now, through careful organisation and the application of science to agriculture, New Zealand was a prosperous country, exporting a considerable amount of produce to England. S. R. I.

THE INSTITUTION OF NAVAL ARCHITECTS.

THE spring meetings of the Institution of Naval Architects opened on Wednesday, March 24. Owing to the war, the meetings were curtailed somewhat; eleven papers were read and discussed at morning and afternoon meetings on Wednesday and Thursday. The Marquis of Bristol was re-elected president for the ensuing year, and in his opening address made reference to Germany's methods of submarine war. He suggested that, in order to obtain reasonable protection from submarine attack, it might be advisable to arm all merchant vessels to an extent which would render them dangerous to submarines.

Prof. J. J. Welch's paper on the watertight subdivision of ships was limited to a discussion of the orderly subdivision of ships, particularly as effected by transverse watertight bulkheads. The paper included a historical sketch leading up to the work of the bulkhead committee of 1912. One of the difficulties which had to be faced by this committee was the question of permeability. The same ship, whilst loaded to the same water-line, might carry cargo of very different density, so that with the same arrangement of bulkheads different standards of safety would obtain on the two voyages. Ultimately the conclusion was reached that a fair average permeability for cargo spaces was 60 per cent. Spaces devoted to passengers are taken at 95 per cent. permeability, and machinery spaces at 80 per cent. The paper goes on to discuss the recommendations of the bulkhead committee's report on oversea passenger vessels, and the author considers that the proposals in the report represent a very decided step forward.

An interesting paper on the influence of discharging appliances on the design of large ore carriers was read by Mr. John Reid. The shipment of ore on the Lakes Superior and Erie route has reached in one year the enormous total of nearly 50,000,000 tons. The author gives a description of the Hulett unloading machine, an appliance which has enabled a cargo of 10,000 tons of ore to be unloaded on the Great Lakes in less than three hours. Unloading and loading machinery of this description has led to the design of ore-carrying steamers in which the greater part of the length of the vessel is taken up with cargo holds, and practically the whole deck is covered with hatches. The rapid loading of such vessels is apt to produce great strains; a speaker in the discussion instanced a case of one of these vessels acquiring a deflection of 11½ in. during loading. The author of the paper directed attention to the backward state of the facilities in Great Britain for handling and transporting ore, and showed how some of the leading features of the Great Lake ore-carriers may be adapted with advantage for ocean-going ore-carriers.

Mr. J. Montgomerie read a paper on the scantlings of light superstructures, by which is meant the light steel deckhouse erections now commonly fitted above the strength deck in passenger steamers. Two alternatives present themselves to the designer:—(1) The structure may be made so flexible that it cannot take any share in the straining action to which the vessel is exposed as a whole; (2) it may be made strong and rigid enough to share that general straining action without damage. The first method of design is impracticable, since the superstructures have to carry heavy weights such as boats, casings, and funnels, and the structure has to be substantial enough to support these when the ship is moving in a seaway. Partial flexibility may be obtained by cutting the superstructure at several places and fitting expansion joints. The whole efficiency of such joints, in respect of the relief from stress which they afford to a long house,

depends on the distance between them, and that in turn states a problem in shipbuilding which has never been solved satisfactorily, viz., the determination of the distribution of stress in way of an abrupt discontinuity, such as a bridge, or other erection. In the absence of any theory to which complete assent can be given, we must turn to the record of experience. The author then proceeds to give descriptions and illustrative sketches showing typical cases of damage to existing ships at places of discontinuity. These examples are of particular value to engineers and others interested in the strength of materials, and will well repay careful study.

An analysis of the damage observed supports certain conclusions which can be drawn from a consideration of the whole question of superstructures:—(1) That in way of a discontinuity in the structure of a ship, stresses outside the erection will be transmitted to the material of the deeper girder much more rapidly than has been thought to be the case; (2) that the fitting of expansion joints, spaced as in the present practice, does not appreciably relieve the superstructures of stress, or obviate damage; (3) the best method of providing against damage in deckhouse superstructures is to dispose the material so as to make these capable of taking part in the straining action of the hull, following as far as possible the general law that all discontinuity of longitudinal material should be minimised. The author then proceeds to take certain typical cases, and gives methods of working out the scantlings required to comply with (3), above noted.

Mr. F. W. Lanchester gave a contribution to the theory of propulsion and the screw propeller. The author made reference to the controversy in which Dr. Froude's work was attacked violently by Prof. Henderson. Without entering, or taking part, in the dispute, Mr. Lanchester reviews the theory from its foundation, in order to make sure of his own ground. In the past there appears to have been insufficient attention to the initial definition of the problem, with corresponding uncertainty as to the ultimate interpretation of results. In discussing Dr. Froude's theory, and speaking academically, Mr. Lanchester says that the weak point of the whole conception is that there is no proof offered that either the work done (*i.e.* the energy expended), or the momentum communicated, is confined strictly to the column of fluid passing through the actuator, and there is, in fact, nothing to restrict, or confine, the fluid as in the case of the efflux theory, by which the problem is rendered really definite. It is understood that the *régime* contemplated by Dr. Froude is not capable of exact expression. This, however, is no obstacle to the application of any theory in real hydrodynamics; if it were necessary for the engineer to await the work of the pure mathematician in these matters, the subject would have made scarcely perceptible progress since the time of Noah. In such a case as the present, if the method of treatment contains 80 or 90 per cent. of truth, it may demand acceptance.

Further work at the William Froude National Tank on the resistance of mercantile ship forms was presented by Mr. J. L. Kent, and Mr. Stromeyer contributed an interesting paper on the law of fatigue applied to crankshaft failures.

EAR PROTECTION AGAINST ARTILLERY SOUNDS.

THOSE who have associated with our gunners must have noticed how often they suffer from deafness. The sudden access of pressure in the neighbourhood of a gun at the moment of firing imposes so great a strain on the drum of the ear that deafness is a usual result. The increase in pressure in the modern gun, and the high pressure still remaining when the shot reaches the muzzle, make the conditions more serious than they used to be comparatively recently. Not only those who are near the gun when fired, but those also in the neighbourhood of bursting shells, bombs, or explosives, are liable to suffer in a similar way even if they are not otherwise damaged.

Mr. A. Mallock, F.R.S., who has for many years conducted investigations in connection with artillery, has invented an "ear defender," the object of which is to protect the drum of the ear from very sudden and violent access of pressure, while still allowing the minute variations produced by ordinary sounds to be received with but little loss. The defender consists of a containing piece made of ebonite and shaped like the pieces used in the game of Halma, and of about the same size. The ball end is very finely milled, and it is made to fit the passage of the ear, there being five sizes, differing very slightly in size in this part, to suit different people. The piece is pierced centrally by a hole 5 mm. in diameter at the small end, and gradually enlarging towards the other end, where it opens into a recess 1 cm. in diameter. Into this are fitted in order a flat ring washer, a disc of fine wire gauze, a very thin, flat ring washer, a delicate diaphragm, a very thin, flat ring washer, a disc of fine wire gauze, and a flat ring washer. When a pair of defenders are placed in the ears, the thin diaphragms, untouched except near their edges, where they are held, are free to take up aerial vibration and to transmit it to the ear passage, and so the wearer hears ordinary sounds with but little loss; when, however, the violent impact due to gun fire or explosion in the neighbourhood occurs, the diaphragm is brought up against the wire gauze, by which it is prevented from further movement, thus limiting the increase of pressure in the air passage and defending the ear.

The defenders are neatly packed in a small tin matchbox with a rubber fitting, which prevents them from falling out, but which allows them to be removed at once. A small cleaning tool is similarly held elastically so that it cannot fall out by accident. The price of the set is three shillings, and at the present time there is great scope for its use. The instrument is called the Mallock-Armstrong ear defender, and the address of the proprietors is 86 York Street, Westminster. C. V. B.

SOME SCIENTIFIC ASPECTS OF PIANO-PLAYERS.[1]

THERE are few modern inventions which have not been employed in the present war for the destruction of property and of human life. The pneumatic piano-player is an exception. It is also exceptional in that it possesses but a scanty literature outside the catalogues of the manufacturers. It has never been associated with any inventor of distinction, and the general public knows nothing about its history. The aeroplane, on the other hand, is closely linked in popular thought, not only with such modern names as Wright, Langley, and Blériot, but also with the names of early designers and projectors of flying machines, such as Dante of Perugia and Leonardo da Vinci. Yet, considered merely from an engineering point of view, the modern piano-player is a marvel of human ingenuity.

The feature which distinguishes it from its early predecessors is the element of controllability, which leaves the interpretation of the music largely to the

[1] Abridged from a discourse delivered at the Royal Institution on Friday, March 19, by Prof. G. H. Bryan, F.R.S.

choice of the performer. Of recent years, however, personal control has been supplemented by accent devices, automatically operated, the construction of which is essentially an engineering problem. The separation of the scale into two independently controlled halves was certainly to be found in the old mechanical pianotist in 1902, and it may date from still earlier. I consider this last feature unnecessary, and its use open to serious objections.

The object of my experiments has been to apply dynamical and physical principles to the control of what I will call the striking action in piano-players, as it very soon appeared to me probable that by so doing it would be possible to obtain differences of effect that could not be produced by purely mechanical methods.

The ordinary practical man asserts that in striking a note or chord on the piano you can increase or decrease the force of the blow, but that the only effect will be to play the whole chord louder or softer, so that you cannot bring the bass or treble parts into prominence unless you connect the pneumatics with different degrees of vacuum. I have been told that it is mathematically impossible to produce effects without which I now regard no piano-player as worth playing.

But any mathematical physicist will understand that what engineers call the "force of the blow" is in reality a very complex phenomenon. In my piano I find that a fairly soft note is produced *in the middle of the scale* when the hammer strikes the strings with a velocity of 30 cm. per second, and that the hammers themselves rise through a height of about 5 cm. This means that *if the acceleration were uniform* the operation of depressing the key and releasing the hammer would occupy one-third of a second. But during the operation the pressure applied to the key may be increased or decreased in an infinite number of ways. It may be made very large at the commencement of the blow, sinking to zero at the end, as when a finger-pianist strikes the note from a height; or it may be very small at first and gradually increased, an action which some describe as a "caressing" touch. These differences would be represented by differences in the shape of the graph connecting the pressure on the key with the time measured from the instant it is first touched to the instant that the note is sounded. We might call them differences in the "shape of the blow." But the check action greatly influences the character of the accelerating force impressed on the hammer when regarded as a function of the time. The operation of playing a note is usually divided into two periods. At the end of the first period a support is withdrawn from the palet which raises the hammer, and the latter becomes disconnected. In the second period either the hammer may fly up freely and strike the note, or the palet may again overtake it and drive it forwards. To produce these different actions the variable forces applied to the key of a piano must evidently be similar in character to the "screw-back" and "following" strokes in billiards. It is, of course, theoretically possible that the hammer may rebound and strike the string a second time. But it is very difficult to test this point.

Another important point is that, as the driving force is applied close to the base of the hammer, considerable flexural vibrations are liable to be set up in the shaft. These may probably differ in amplitude and phase, according to how the note is struck. A difference in this respect may affect the tone-quality.

Now the bass and treble hammers differ considerably in weight, and therefore also in inertia, and the intermediate hammers vary continuously from one end of the scale to the other. It follows that a short sharp blow will produce its greatest effect in the higher parts of the scale, while a longer sustained blow, or an increasing blow, will drive the bass notes forward with increased velocity even after the treble notes have been released.

In the case of a repeated treble note with bass accompaniment the second time it is struck, accentuation is more difficult, and there is considerable danger of the note failing to sound owing to the bridge between the two notes buckling, thus continuously admitting air to the primary valves. The best plan is to keep the tension low until the chord containing the repeated note has passed the tracker board, and then force the notes down hard. On account of the additional difficulty thus incurred in reading the music, I believe that it would be justifiable to cut the troublesome note a little after the accompanying chord.

The apparatus originally used in these experiments was figured and described in NATURE of May 8, 1913 (vol. xci., p. 246), but the principle has now been embodied in a patented device which the Moto Music Company, of 42 Eyre Place, Edinburgh, have undertaken to fit to any make of internal or detachable player, and which in the case of a player-piano does not interfere with the appearance of the instrument or its use when required for hand playing. In addition to the suction bellows which generates the vacuum, all pneumatic players have a large reservoir bellows, which acts as an accumulator or condenser of considerable capacity, but between this and the playing pneumatics two channels of communication usually exist. One is through an accent valve controlled by a lever, the other connection is through a smallish regulating bellows, controlled usually by a spring, and through an air valve which opens or closes with it according to the degree of vacuum. This arrangement is sometimes called a "choker," and its statical action tends to equalise the pressure of the air from the playing pneumatics.

Now it will be found that in playing the regulating bellows is in a continual state of vibration, and that this vibration has a very marked effect upon the tone quality and expression. The character of the variable force applied in projecting the pianoforte hammer is determined very largely by the elasticity of the controlling spring, and the fact that this remains constant is found to account for the dulness and want of variety which is noticed even in the best players when they have been in use for a certain time. In my device the spring is replaced by a weight the leverage of which can be varied, thus enabling the tension on the bellows to be varied from time to time in playing different passages, and introducing, further, a variable element of inertia. It is convenient to describe such changes as "sub-permanent." Further, the bellows can be controlled by a hand lever for the purpose of accentuating individual notes, such changes being describable as "temporary." The usual expression marks, F F, F, M F, P, and P P, are indicated.

The experiments lead to the following conclusions:—

(1) A light sub-permanent tension with fairly strong pedalling will give bright treble effects with light bass. A heavy sub-permanent tension with light pedalling produces a strong bass and a soft treble.

(2) Corresponding to every note of the scale, there is an action which produces the maximum effect, this action varying continuously from one end of the scale to the other.

(3) The brightest effects are obtained by keeping the accent valve open, or partly so, as in this case the closing of the regulating bellows is affected by the pedalling. The effect of closing the accent valve is very similar to the use of the soft pedal.

(4) In playing solo passages, light and heavy sub-

permanent tensions produce different effects even when it is sought to maintain the corresponding degree of loudness by suitable variations in the strength and method of pedalling. This observation leads us to believe in the existence of a relation between tone-quality and touch. While it is easy for an inexperienced person to produce the necessary differences of touch with a pneumatic player fitted with this controlling device, I find it very difficult to obtain the same effects by striking the keys of an ordinary piano with my fingers.

(5) There appear to be two different ways of accenting particular parts of chords by hand pressure applied to the control lever. With a slight sub-permanent tension, treble notes are usually best accented by depressing the lever before the note has reached the tracker board, and subsequently allowing it to fly up smartly. With a heavy sub-permanent tension, it is necessary to jerk the lever upwards from below just after the note has reached the tracker board. For a bass note with light tension, the lever is firmly pressed down after the note has reached the tracker. With heavy tension the lever is previously raised, and then allowed to drop down with the note. In either case the action is supplemented by a corresponding action in pedalling.

(6) With a heavy sub-permanent tension and the lever supported from below, it is possible to obtain very soft effects in which the treble parts ring out clearly and are not drowned by the bass. With a light sub-permanent tension and the lever pressed down the results are more brilliant. I attribute these differences to the inertia of the controlling weight.

(7) There is a great satisfaction in being able to slam down a vigorous chord, hand and foot working in unison.

(8) In the earlier experiments the connection between the lever and the bellows was made first with strings and tapes, and afterwards with wires passing over pulleys. It was found, however, that the stretching of these connections greatly interfered with the effects and led to the production of harsh results, and the connections frequently broke.

(9) The best accentuation of particular notes in chords is obtainable when the notes reach the openings in the tracker board at exactly the same instant. When they are cut unevenly it is often very difficult to accentuate at will either the upper or lower notes of a chord.

(10) With experience it is possible to learn the exact kind of effort required to accentuate a note in any part of the scale, and thus to obtain marked differences between the treble and bass parts of a comparatively short chord.

(11) Where a note or chord is repeated a number of times in rapid succession it is advantageous to hold the controlling lever firmly. This obviates all the strain on the ankles in pedalling, which under ordinary conditions is considerable.

(12) In every case the exertion of pedalling is greatly reduced, not improbably by about 50 per cent.

(13) Some players have separate regulating bellows for the bass and treble parts, but this does not interfere with the working of the device.

(14) A very small effort often produces a considerable difference in the effect. It is possible to emphasise a particular note or chord by a suitable stroke of the pedals alone, but the lightest possible touch of a finger applied to the lever will often produce a conspicuous improvement in the effect.

(15) Experiments with pianos of different makes, both upright and horizontal, operated by either detachable or interior players, lead to practically identical results.

Although I have been trying for a long time past to account theoretically for the observed effects, the results are still far short of finality. It is clear that neither Helmholtz's nor Kaufmann's mathematical investigations fully suffice for the purpose. There are, however, other difficulties. One is that, although it is easy to observe differences of effect which are, as a rule, quite conspicuous, it is not as easy to define exactly in what these differences consist. Again, the success of a piano-player as a musical instrument largely arises from the fact that the manipulation of the various controls, both for tempo and expression, soon becomes intuitive. A great deal evidently depends on the elasticity of the muscles of the hands and feet. It would be very difficult to ascertain precisely the effect of differences in this elasticity on the tension in the playing pneumatics while a note is being sounded. In short, it appears probable that a complete dynamical theory of the observed effects will involve investigations of no small degree of difficulty. The mere engineering of this control device into a form in which it can easily be adapted to any internally fitted player without interfering with its use for hand playing, has given Mr. Ireland a great deal of trouble. It is now important that the experiments should be repeated by a number of different independent observers, and their experiences compared; until this is done it would be futile to proceed much further in seeking a theoretical explanation.

Educational Problems.

The average children of player owners will not wish to spend much time in acquiring manual dexterity with scales and five-finger exercises. In place of the present "practising," they will practise exercises in player manipulation, and begin by learning the meaning of the expression marks on the roll. The exercises will be mainly devoted to :—

(1) The control of the speed regulator and the acquisition of the subconscious or instinctive faculty of playing every note or chord at the desired instant. Practice in accompanying.

(2) The production of differences of expression and touch, including those described in this lecture, and the acquisition of the power of accenting parts of chords in any part of the scale. The pupil must not be satisfied until he has learned the exact action corresponding to every note on the keyboard. For school practice automatic accent perforations and separation of bass and treble halves must be forbidden. A school prize should be given for the best rendering of some composition.

The pupils will, however, require some familiarity with the structure of music, and musical notation. For this purpose there will be needed a scale to be placed in front of the tracker showing the black and white notes, and in addition special rolls marked in such a way as to illustrate :—

(1) The rulings of the treble and bass clef in the ordinary staff notation.

(2) The relative value of semibreves, minims, crotchets, quavers, etc., and the corresponding rests.

(3) The distribution of the sharps and flats in different keys.

(4) The meaning of such terms as staccato, legato, arpeggio, trills, etc.

(5) The lengths of the various musical intervals, such as major third and minor fifth.

Finally, in order to acquire practice in reading music, the pupils may learn to cut their own music rolls. Appliances for this purpose are already obtainable, and will doubtless become common in the future. A school class in roll cutting should prove an efficient

form of manual training, and prizes could be given for the best cut roll.

NOTE 1.—Owing to the war, I have dropped an application for a German patent, which was made several months previously to its outbreak. Still, I think it desirable that readers of NATURE should see the following criticism by the examiner of the Patent Office at Berlin.

"Owing to the replacement (which is very obvious) of the customary springs by weights, the action of the regulating bellows cannot be improved, but only made worse, since the action will not take place more rapidly but more slowly."

This objection shows the absurdity of placing important decisions regarding the validity of patents, and equally important other matters in the hands of officials who are not in touch with the actual facts of the case. In this case the patent examiner's decision is not backed up either by experimental evidence or by exact mathematical investigations, and his decision is just what might be expected in the circumstances, but is, none the less, hopelessly in error. As a matter of fact—

(1) My experiments prove conclusively that the action of the regulating bellows, instead of being "*made worse*," is greatly "*improved by the replacement of springs by weights.*" That this effect is not "*very obvious*" is shown by the fact that the examiner has conspicuously failed to realise its advantages.

(2) My experiments can only be explained on the hypothesis that "*on account of the necessary accelerations of the weights, the action will not take place more rapidly but more slowly*," and that this retardation is proved experimentally to give greatly improved results, even though this conclusion is contrary to our preconceived opinions.

No doubt arguments similar to those raised by the German Patent Office would naturally be raised by anyone who had not tested the question by actual experience. But if these objections give any clue to the extent to which the modern piano-player has been perfected up to the present time by German inventions accepted by the Berlin Patent Office, the results must be regarded as hopeless failures.

NOTE 2.—The differences of tone quality produced by differences of touch in my experiments would appear to be identical with those obtained by finger playing which are largely responsible for the success of Prof. Tobias Mathay's pianoforte school. It would, however, appear that some pianos are incapable of exhibiting these differences, and Prof. Mathay unfortunately found when it was too late that the piano kindly lent for the lecture was defective in this respect. I have since tested another player-piano and found an absolute constancy of tone quality, whether played manually or pneumatically.

SCIENTIFIC WORK OF THE SMITHSONIAN INSTITUTION.[1]

Researches and Explorations.

DURING the year the institution continued to carry on investigations in various lines throughout the world by means of small allotments from its funds. It also accomplished a great deal in the way of exploration and research through the generosity of friends of the institution, who contributed funds for special work or provided opportunities for participation in explorations which they had undertaken personally or through the aid of others. Each year, however, the institution is obliged to forgo opportunities for important investigations through lack of sufficient funds.

[1] Abridged from the Report of the Secretary of the Smithsonian Institution for the year ending June 30, 1914.

The Langley Aerodynamical Laboratory.

On May 1, 1913, the secretary was authorised to re-open the Smithsonian Institution laboratory for the study of aerodynamics, and in future it was to be known as the Langley Aerodynamical Laboratory. The functions of the laboratory were defined to be the study of the problems of aerodromics, particularly those of aerodynamics, with such research and experimentation as may be necessary to increase the safety and effectiveness of aerial locomotion for the purposes of commerce, national defence, and the welfare of man.

The first year's work of the laboratory was to arrange a comprehensive programme of operations, devise ways and means of carrying on investigations and publishing reports, conduct such active experiments as were possible with the means immediately available, and to secure and arrange in the library the best aeronautical literature.

The first technical publication sets forth the results of experiments made at the model tank at the Washington Navy Yard. Another report describes the organisation and equipment of the leading aeronautical laboratories of England, France, and Germany. Some of the reports of the committee are as yet confidential or incomplete. The library has been furnished with the chief aeronautic periodicals and the best books thus far published.

The rehabilitation and successful launching of the Langley aeroplane (called "aerodrome" by Prof. Langley), constructed more than a decade ago, was accomplished in May, 1914. The machine was shipped from the Langley Laboratory to the Curtiss aeroplane factory in April. It was re-canvassed and provided with hydroaeroplane floats, and was launched on Lake Keuka on May 28. With Mr. Glenn H. Curtiss as pilot it ran easily over the water, rose on level wing, and flew in steady poise 150 ft. Subsequent short flights were made in order to secure photographs of the craft in the air. Then Mr. Curtiss was authorised, in order to make prolonged flights without overtaxing the bearings of the Langley propulsion fixtures, to instal in its place a standard Curtiss motor and propeller. At the close of the fiscal year the experiments were still making satisfactory progress.

The tests thus far made have shown that the late Secretary Langley had succeeded in building the first aeroplane capable of sustained free flight with a man. It is hoped that further trials will disclose the advantages of the Langley type of machine. It may be recalled that this man-carrying aeroplane was begun in 1898 for the War Department, and in the interest of the national defence. It was built on the design of the model machine which, on May 6, 1896, first demonstrated to the world that an aeroplane heavier than air could be propelled through the air by its own power. The large machine was completed in 1903, but its actual flight was at that time hindered by injuries sustained through defects in the launching apparatus.

Geological Explorations in the Canadian Rockies.

In continuation of his previous geological researches in the Canadian Rockies, Dr. C. A. Walcott, the secretary of the institution, revisited during the field season of 1913 the Robson Peak district, in British Columbia and Alberta, and the region about Field, British Columbia.

On this trip Robson Peak was approached from the west side in order to study the local geological section, one of the finest in the world. Owing to exceptionally good climatic conditions the season of 1913

proved unusually favourable for studying Robson Peak. Frequently in the early morning the details of the snow slopes and bedded rocks on the summit of the peak were beautifully outlined, but toward evening the mists, driven in from the warm currents of the Pacific, 300 miles away, shrouded the mountain from view.

From the west slopes of Titkana Peak, east of the great Hunga Glacier, a wonderful view is obtained of the snow fields and falling glaciers east and north of Robson Peak. The glacial streams come tumbling down the slopes and often disappear beneath the glacier to reappear at its foot with the volume of a river.

At Field, British Columbia, work was continued at the great Middle Cambrian fossil quarry, where a large collection of specimens was secured. It was necessary to do much heavy blasting to reach the finest fossils which occur in the lower layers of rock.

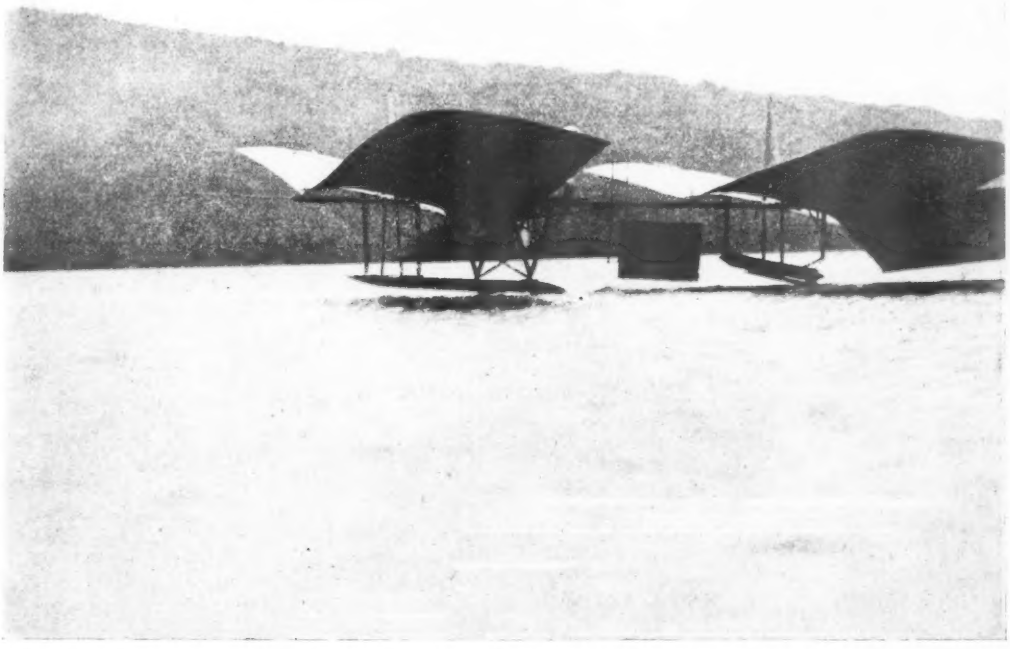

FIG. 1.—Langley man-carrying aerodrome (built 1898–1903) equipped with floats, in flight over Lake Keuka, Hammondsport, N.Y., June 2, 1914.

The collection of 1913 contains a number of very important additions to this ancient fauna and many fine specimens of species found in 1912. A report on these collections is now in preparation.

Geologic History of the Appalachian Valley in Maryland.

Dr. R. S. Bassler, of the National Museum, spent a month during the summer of 1913 in the Appalachian Valley of Maryland and the adjoining States, studying the post-Palæozoic geologic history of the region, as indicated by the present surface features. Since Carboniferous times western Maryland has been above the sea, and its rocks have accordingly been subjected to a long period of aerial erosion. During Jurassic time the area remained stationary for so long a period that the surface of the land in the Appalachian province was reduced to a rolling plain. Later uplift raised this plain still higher above sea-level, and in Maryland only remnants of the old surface are preserved in the flat sky line of the highest mountains. This ancient plain, or Schooley peneplain, as it is termed, is well preserved on the top of the Blue Ridge.

A second great period of erosion occurred in early Tertiary times, the effects of which were chiefly in the Appalachian Valley proper, where the erosion is indicated by a pronounced plain at an elevation of about 750 ft. This plain was formed only on the softer Palæozoic rocks, and, because of its prominence near Harrisburg, Pa., is known as the Harrisburg peneplain. Conococheague Creek traverses the Harrisburg peneplain in Maryland, and has dissected it considerably, but even the sky line of the ancient plain is still clearly evident.

Other factors in the geologic history of Maryland are recorded in the well-defined gravel terraces along the major streams of the area and in great alluvial fans of large and small boulders, spreading out at the foot of the larger mountains and sometimes reaching a depth of 150 ft.

Pleistocene Cave Deposit in Maryland.

As the results of a further examination of the Pleistocene cave deposit near Cumberland, Md., by Mr. J. W. Gidley, of the National Museum, many new forms were added to the collection, and much better material obtained of several species represented only by fragments of jaws in the first collection. The series now includes more than 300 specimens, representing at least forty distinct species of mammals, many of which are extinct. Among the better preserved specimens are several nearly complete skulls and lower jaws. The more important animals represented are two species of bears, two species of a

large extinct peccary, a wolverine, a badger, a martin, two porcupines, a woodchuck, and the American eland-like antelope. Other species represented by more fragmentary material include the mastodon, tapir, horse, and beaver, besides several species of the smaller rodents, shrews, bats, and others. This strange assemblage of fossil remains occurs hopelessly intermingled and comparatively thickly scattered through a more or less unevenly hardened mass of cave clays and breccias, which completely filled one or more small chambers of a limestone cave, the material, together with the bones, evidently having come to their final resting place through an ancient opening at the surface of a hundred feet or more above their present location

Geological Survey of Panama.

Last year an allotment was made from the institution's funds toward the expenses of an investigation of the geology of Panama. The general plan includes a systematic study of the physiography, stratigraphy, and structural geology, geologic history, geologic correlation, mineral resources (including coal, oil, and other fields), petrography and palæontology of the Canal Zone, and of as much of the adjacent areas of the Isthmian region as is feasible.

Upon the completion of the work the institution will print a general account of the results, and later there will be published a detailed report of the geological data of the Isthmus and adjoining regions.

Vertebrate Fossil Remains in Montana.

During the summer of 1913 Mr. Charles W. Gilmore, of the National Museum, headed an expedition for the purpose of obtaining a representative collection from north-western Montana. Between 500 and 600 separate fossil bones were obtained, many of them of large size. The most notable discovery was a new Ceratopsian or horned dinosaur, the smallest of its kind known. There were portions of five individuals of this animal recovered, representing nearly all parts of the skeleton, making it possible to mount a composite skeleton for exhibition. Although Ceratopsian fossils were first discovered in the Rocky Mountain region in 1855, and portions of a hundred or more skeletons have been collected, this is the first individual to be found having a complete articulated tail and hind foot. It thus contributes greatly to our knowledge of the skeletal anatomy of this interesting group of extinct reptiles. Another find was a partial skeleton of one of the Trachodont or duck-billed dinosaurs recently described from specimens obtained in Canada, and its discovery in Montana greatly extends its known geographical and geological range. Less perfect skeletons of carnivorous and armoured dinosaurs, turtles, crocodiles, and ganoid fishes were also obtained.

FIG. 2.—Langley man-carrying aerodrome (built 1898–1903) equipped with floats, in flight over Lake Keuka, Hammondsport, N.Y., June 2, 1914.

Life Zones in the Alps.

Dr. Stejneger, head curator of biology in the National Museum, visited the eastern Alps towards the close of the last fiscal year, to make further observations toward a determination of the limits of the life zones, which in that part of Europe might correspond to those established in North America. That a system of such life zones exists in Europe has long been more or less vaguely stated by authors, but although a definite correlation was established by Dr. Stejneger and Mr. Miller in 1904, certain points, especially the interrelation of the zones corresponding to the so-called Canadian and Hudsonian life zones in America, were greatly obscured by the long-continued interference of man and animals with nature, such as the

grazing of cattle in the high Alps, deforestation, and, more recently, artificial reafforestation. It was thought that the eastern Alps might show more primitive conditions. Dr. Stejneger visited the mountain region between Switzerland and the head of the Adriatic. Arrived at the town of Bassano, at the foot of the Venetian Alps, he began to study the life zones of the Val Sugana and the plateau of the Sette Comuni from that point. He made a series of excursions from Bassano, Levico, and Trento as successive headquarters. He was able to trace the boundaries of the Austral life zones in considerable detail, as well as to gather data which connect with the previous correlation of these zones in the western Alps and with the corresponding zones in North America. It was found that the bottom of the entire Val Sugana belongs to the upper Austral zone.

Researches under Harriman Trust Fund.

Dr. C. Hart Merriam continued during the year to carry on certain natural history and ethnological investigations provided for by a special trust fund established by Mrs. E. H. Harriman for that purpose. His principal work during the year was on the big bears of America. In furtherance of this study, specimens have been placed at his disposal by numerous sportsmen and hunters and by the larger museums of the United States and Canada. In the course of his investigations a transcontinental line was run across the country to the coast of California by which the easternmost limits of range were determined for a number of species of mammals, birds, reptiles, and plants. And while traversing Utah and Nevada several remote tribes of Indians were visited, particularly the Gosinte, from whom a long-needed vocabulary was obtained.

Anthropological Research in Eastern Asia.

For the extension of researches in eastern Asia, in continuation of anthropological investigations carried on in Siberia and Mongolia under the direction of the institution in 1912, an allotment has been made from the Smithsonian fund for work during the next fiscal year and for a limited period thereafter. The plan of operations includes a thorough study of the peoples of the eastern coast of Asia, Manchuria, Mongolia, Tibet, and Siberia, among whom it is believed lies the secret of the origin of the American Indian. Investigations thus far made by Dr. Hrdlička on behalf of the institution indicate, he says, "that there exist to-day over large parts of eastern Siberia and in Mongolia, Tibet, and other regions in that part of the world numerous remains which now form constituent parts of more modern tribes or nations, of a more ancient population (related in origin, perhaps, with the latest Palæolithic European), which were physically identical with, and in all probability gave rise to, the American Indian."

Researches under the Hodgkins Fund.

The Hodgkins fund was established in 1891 by a gift of 40,000*l.* from Mr. T. G. Hodgkins. By subsequent gifts the fund has increased to about 50,000*l.* It was stipulated by the donor that the income of 20,000*l.* of his gift should be devoted to the increase and diffusion of more exact knowledge in regard to the nature and properties of atmospheric air in connection with the welfare of man He indicated his desire that researches be not limited to sanitary science, but that the atmosphere be considered in its widest relationship to all branches of science, referring to the experiments of Franklin in atmospheric electricity and the discovery of Paul Bert in regard to the influence of oxygen on the phenomena of vitality as germane to his foundation. To stimulate researches in these directions the institution offered a prize of 2000*l.* for a paper embodying some new and important discovery in regard to the nature and properties of atmospheric air, which was awarded in 1895 to Lord Rayleigh and Sir William Ramsay, of London, for the discovery of argon, a new element in the atmosphere. Another prize of 200*l.* for the best popular treatise on atmospheric air was awarded to Dr. H. de Varigny, of Paris. Numerous investigations on the "composition of expired air and its effects upon animal life," in "atmospheric actinometry," the "air of towns," "animal resistance to disease," "experiments with ionised air," "the ratio of specific heats," and kindred topics have been carried on with the aid of grants from the Hodgkins fund. Researches have likewise been aided in connection with the temperature, pressure, radiation, and other features of the atmosphere at very high altitudes, extending during the past year to more than 45,000 feet, and many other lines of investigation have been carried on, through all of which it is believed that valuable knowledge has been acquired by which the welfare of man has been advanced.

Under a grant from the Hodgkins fund Mr. A. K. Ångström carried on some observations in California during the year for the purpose of measuring nocturnal radiations at different altitudes ranging from below sea-level to the summit of Mount Whitney, 4420 metres (14,502 ft.).

A grant was also made to Mr. Ångström to enable him to measure the "nocturnal radiation"—that is, loss of heat to space during the total eclipse of the sun, August 21, 1914, in the north of Sweden.

In connection with the International Congress on Tuberculosis held in the National Museum in 1908, the institution offered a Hodgkins fund prize of 300*l.* for the best treatise on "the relation of atmospheric air to tuberculosis." The prize was divided equally between Dr. Guy Hinsdale, of Hot Springs, Va., and Dr. S. Adolphus Knopf, of New York, for their essays.

Research Corporation.

In February, 1912, the Research Corporation was organised under the laws of New York as a means for furthering scientific and technical research. Its principal object is—to acquire inventions and patents and to make them more available in the arts and industries, while using them as a source of income, and, second, to apply all profits derived from such use to the advance of technical and scientific investigation and experimentation through the agency of the Smithsonian Institution and such other scientific and educational institutions and societies as may be selected by the directors.

The Smithsonian Institution is interested in the management of this corporation through the membership of the secretary in its board of directors. The chief assets of the corporation at present are the Cottrell patents relating to the precipitation of dust, smoke, and chemical fumes by the use of electrical currents. A number of other patents in various fields of industry have been offered by officers of the Government and scientific institutions, as well as by manufacturing corporations holding patents not available for their own purposes, and undoubtedly there are many others, both in this country and abroad, who will be glad to have their inventions utilised for the benefit of scientific research.

National Museum.

The growth of the museum during recent years has been greater than during any prior period of its history. The natural history collections are now given adequate room in the spacious halls of the new building. Increase in every division of the three principal departments of the museum—anthropology, biology,

and geology—is now welcomed both for purposes of exhibition and in the study series.

Bureau of American Ethnology.

The work of the Bureau of American Ethnology during the year has brought together much new material relating to the habits and customs and the languages of the American Indians. One of special interest was a reconnaissance by Mr. F. W. Hodge, ethnologist-in-charge, of a group of prehistoric ruins on a mesa in Cebollita Valley, N. Mex. These ruins consist of a number of house groups forming a compound built on an almost impregnable height, and designed for defence; not only the groups but the individual houses have the form of fortifications, while the vulnerable point of the mesa rim is protected by means of a rude breastwork of stones. Among the special features of interest which Mr. Hodge discovered were a burial cist in which skeletons, pottery, and the remains of a mat were found; three small cliff lodges situated in the sides of the cliffs; several ceremonial rooms or kivas associated with the ruined houses; and the remains of the early reservoirs of the inhabitants.

National Zoological Park.

The collection in the park is the outgrowth of a small number of living animals which for several years had been assembled in very crowded quarters near the Smithsonian building, mainly for the purposes of scientific study. Chiefly through gifts and exchanges the size of the park collection has gradually increased, until it now numbers 340 species of mammals, birds, and reptiles, represented by 1362 individuals.

Astrophysical Observatory.

The work of the Astrophysical Observatory has comprised observations and computations at Washington and in the field relating to the quantity of solar radiation, its variability from day to day, and the effect of the atmospheric water vapour in absorbing the radiations of great wave-length such as are emitted toward space by the earth. Much attention has been given to the design, construction, and testing of new apparatus for these researches, including apparatus for measuring the sky radiation, special recording pyrheliometers to be attached to free balloons for the purpose of measuring solar radiation at great altitudes, and a tower telescope at the Mount Wilson Station.

The principal results of the year include: a new determination of the number of molecules per cubic centimetre of gas, depending on measurements at Mount Wilson of the transparency of the atmosphere; successful measurements by balloon pyrheliometers of the intensity of solar radiation up to nearly 45,000 ft. elevation above sea-level. The results tend to confirm the adopted value of the solar constant of radiation. Most important of all, the investigation by the tower telescope at Mount Wilson shows that the distribution of radiation along the diameter of the sun's disc varies from day to day and from year to year. These variations are closely correlated with the variations of the total amount of the sun's radiation. Thus the work of the year yields an independent proof of the variability of the sun and tends to elucidate its nature.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Dr. Douglas Stanley has been appointed to the chair of therapeutics.

Dr. L. G. Parsons has been appointed to the newly created lectureship in infant hygiene and diseases peculiar to children.

Dr. C. K. Tinkler is resigning his post as lecturer in chemistry on his appointment to the London University readership in chemistry in the department of home science at King's College.

CAMBRIDGE.—An exhibition of 50*l.* a year tenable for two years is offered each year by the governing body of Emmanuel College to a research student commencing residence at Cambridge as a member of Emmanuel College in October. The governing body may award additional exhibitions of smaller value should properly qualified applicants present themselves. The exhibitions will be awarded at the beginning of October. Applications, accompanied by two certificates of good character, should be sent to the Master of Emmanuel not later than September 24.

IT is stated in the issue of *Science* for March 12 that the Massachusetts Committee on Education voted unanimously on February 25 in favour of "taking initial steps toward the establishment of a State university."

DR. F. J. GOODNOW will be formally inaugurated president of the Johns Hopkins University on or about May 20. According to *Science* it has been arranged to give the occasion a double significance, for, in addition to the inauguration of the third president of the University, the new site at Homewood is to be dedicated formally.

THE scientific advisory committee of the University of Sheffield has recently held, on March 18, 19, and 20, an exhibition of British-made laboratory apparatus and material, with the double object of acquainting consumers with sources of supply, and of obtaining support for the new industries so as to enable them to become permanently established. The exhibits included glass and porcelain ware of different kinds and different sources of manufacture, glass wool, transparent and opaque silica ware, acid-resisting metals, filter papers, and a variety of clay goods. The exhibition aroused considerable interest in Sheffield and the neighbourhood, and great satisfaction was expressed by visitors at the progress which the manufacture of laboratory ware has made in this country in the period since the war began.

THE Board of Education has published a "Memorandum on the Teaching of Engineering in Evening Technical Schools" (Circular 894, price 6*d.*). Its object is to furnish suggestions to teachers and organisers of schools which provide evening classes in mechanical and electrical engineering, and not to lay down a scheme of instruction suitable for universal application. The need for a great variety both in methods and organisation, to meet the needs of students working in different areas under special industrial conditions, is borne in mind throughout. Part-time courses only are considered in the memorandum, and such subjects are dealt with as the classification of the courses, suitable curricula, and the outlines of laboratory and class work. The detailed outlines of work for courses in mechanical and electrical engineering to suit students of different grades will provide teachers with practical help in modifying and improving their own syllabuses of instruction.

THE annual report of the University College, London, Committee shows that the total number of students for the session 1913–14 was 2206, including in the faculty of science 148 men and 50 women; in the faculty of medical sciences, 138 men; in the faculty of engineering, 134 men; post-graduate and research students, 313 men, 128 women. Of evening students there were in the faculty of science 22 men, 29 women. For the current session, 1914–15, owing to the war, there has been a decline in the total

number of 335, the decline in full-time students up to the present date being 462. The fall in numbers will involve a decrease in fees of not less than 10,000*l*. The "Pro Patria" list already issued contains 665 names, distributed as follows:—Army, 523; Navy, 30; Officers Training Corps, 69; Red Cross work, already abroad, 17; voluntary aid detachment, ready for service, 26. A large number of refugee students has been received, each student paying a nominal fee. The number admitted since the beginning of the session has been 116; at the opening of the second term, the number actually at work was 81. The college staff, with the help of its friends, has provided hospitality for about forty-eight persons, and has raised a sum of nearly 300*l*. to aid the students. The revenue of the college in 1913–14 was 71,567*l*., the expenditure 71,260*l*. Members of the college have already indicated their willingness to assist in helping towards the deficit created by the war. The completion of the new buildings has been delayed by the war. A special effort on the part of the Equipment and Endowment Fund Committee is to be made to raise the remainder of the sum necessary for the completion of the chemical laboratories. The sum still needed for this purpose is 13,650*l*., the greater part of which (10,000*l*) is required for the special equipment of a physical and electrical chemistry laboratory. The national need of improved facilities for chemical education emphasises the desirability of completing the equipment of these new laboratories.

SOCIETIES AND ACADEMIES.

LONDON.

Mineralogical Society, March 16.—Dr. A. E. H. Tutton, president, in the chair.—Prof. G. **Cesàro**: Orpiment from Balia, Asia Minor. Results of a crystallographic examination were given.—Prof. G. **Cesàro**: Stereographic projection of a cone touching the sphere of projection along a small circle.—Dr. S. **Kôzu**: The dispersion of adularia from St. Gothard, felspar from Madagascar, and moonstone from Ceylon. A second communication giving the results of careful measurements.—Dr. G. T. **Prior**: The meteoric stone of Launton, Oxfordshire. The stone, which was seen to fall on February 15, 1830, was acquired by Dr. Lee and placed in his natural history collection at Hartwell House, near Aylesbury. After his death it was, through confusion with another meteorite, lost sight of until 1895, when it was found by Dr. Fletcher wrongly labelled in the Lee collection, and was secured for the British Museum. The stone belongs to the white-veined chondrite group, and in chemical and mineral composition agrees with other members of that group.

Linnean Society, March 18.—Prof. E. B. Poulton, president, in the chair.—J. A. **Wheldon** and W. G. **Travis**: The lichens of South Lancashire. In the introductory part of their paper, the authors, after referring to the enormous industrial development and increase of population which took place in South Lancashire during the last century, point out the deterioration of the flora which ensued, and then proceed to detail the results of their study of the effects of air-pollution by coal-smoke on the cryptogamic vegetation, and more particularly on lichen-growth. They are of opinion that South Lancashire exhibits the deleterious effects of smoke on vegetation to a higher degree over a larger area than is, perhaps, the case in any other part of Great Britain. They think, however, that these adverse conditions have now reached their maximum. It has, therefore, been considered of importance exactly to describe the state of the lichen-flora as it at present exists, so that data may be afforded for purposes of comparison at some future time when a regenerated lichen-flora has developed under purer atmospheric conditions. The authors show the extent to which the various classes of lichens, more especially those of corticolous and rupestral habitats, have suffered; and in this connection the marked influence of a calcareous substratum in neutralising the deleterious effects of smoke on lichen-growth is discussed. Particular attention has been paid by the authors to the lichens of the coast sand-dunes, the lichens of the Sand-dune Plant Formation in Britain not having hitherto been specially investigated. The characteristic lichens of these dunes and their ecological relations are described. A systematic list of all species of lichens found in the vice-county is given; and four new species and two new varieties are described.

MANCHESTER.

Literary and Philosophical Society, February 23.—Mr. F. Nicholson, president, in the chair.—Prof. W. W. Haldane **Gee**: A projection screen invented by the late Mr. Thomas Thorp. The screen is made by producing a special type of matt surface on glass, on which is then deposited silver. This forms the opaque back of the screen, the front being of transparent glass. The screen gives a well-illuminated picture when employed for ordinary lantern work, and is especially good for use with the projecting microscope. By its means the Brownian motion of colloidal particles, which requires high magnification and great loss of light, can be demonstrated. The screen is most effective when viewed at an angle nearly perpendicular to its surface. A microscopic examination of the surface shows that it is made up of minute convex discs.—Prof. G. Elliot **Smith**: The significance of the geographical distribution of the practice of mummification. Mummification is the most distinctive element of a complexly-interwoven series of peculiar customs, including the practice of building megalithic monuments, sun- and serpent-worship, circumcision, tattooing, etc. The art of embalming certainly originated in Egypt, and, as the practice is of a nature extremely repulsive to mankind, the circumstances must have been of quite an exceptional nature to have driven any people to adopt such a custom. It is altogether unlikely that such a complex combination of special circumstances as we know to have called the practice into existence in Egypt should have arisen in more than one place. The details of the technique, in whatever part of the world the custom is found, emphasise an Egyptian origin. The practice spread from Egypt to the Mediterranean littoral, Europe, and the Canary Islands; to East Africa, Upper Congo, Southern Nigeria; to the Persian Gulf, India, Ceylon, Burma, Indonesia, New Guinea, the islands of the Torres Straits, and thence to Australia. Emigrants from Indonesia carried it to Tonga, New Zealand, Tahiti, and eventually to the Peruvian coast of South America.

PARIS.

Academy of Sciences, March 15.—M. Ed. Perrier in the chair.—René **Garnier**: A class of Abelian systems deduced from the theory of linear equations.—Victor **Vâlcovici**: The theorem of movements of quantities of motion.—A. Le **Bel**: Researches on the catathermic radiation. Experiments on the hypothetical radiation suggested by Tissot.—A. **Leduc**: The ratio γ of the two specific heats of mixtures of gases. Applications. A formula is deduced for the ratio of the two specific heats of gas mixtures based on expressions given by the author in earlier papers, and it is shown that the results are appreciably different from those calculated from the usual method of averages.—Léon **Bloch**: The absorption of gases by resonance.—A. **Portevin**:

The mechanical anisotropy of metals and alloys of coarse grain.—F. de Montessus de **Ballore**: The seismogenic influence of parallel faults.—Pereira de **Sousa**: The macroseisms of 1911, 1912, 1913, 1914, in the north of Portugal. The earthquakes in the north of Portugal (Minho) from 1911 to 1914 were of epirogenic origin. Their maximum intensity was shown along the seismotectonic line Paços de Ferreira-Vila Nova de Famalicão-Barcellos-Caminha, and their maximum extension along the seismotectonic line Vila do Conde-Malta-Gondomar.—G. **Arnaud**: The roots of gummy beetroots. The gummy degeneration of the beetroot, which has been rather marked this winter, is shown to be caused by a bacterium, the isolation and description of which are described.—P. **Carnot** and B. **Weill-Hallé**: The dissemination of the typhoid bacillus round patients attacked with the disease. A study of the various types of typhoid carriers, with some practical recommendations, including the necessity for the prolonged isolation of typhoid patients, rigorous disinfection of the wards and of infected articles, and semi-isolation and hyper-vaccination of the hospital staff.—Maurice **Piettre**: The feeding of armies in the field. A statement of the advantages connected with the use of preserved vegetables.

March 22.—M. Ed. Perrier in the chair.—Paul **Brück**: First elements of the Mellish comet. Based on an observation on February 15 made at Taschkent Observatory, and two observations by M. Coggia made on February 20 and 25.—Emile **Saillard**: The estimation of saccharose in beetroot after freezing and thawing. A considerable proportion of the saccharose has disappeared by a viscous fermentation.—Louis **Rousseau**: Crystallised calcium theobrominate. Lime water and theobromine react at the boiling point forming a crystallised compound which, on analysis, proved to have the composition $(C_7H_7N_4O_2)_2Ca,9H_2O$. The properties of this compound are detailed.—Maurice **Lugeon** and Gerhard **Henny**: The alpino-dinaric limit in the neighbourhood of the massif of Adamello.—Henry **Hubert**: Anomalies in the distribution of the temperature curves in western Africa.—Julien **Loisel**: a representative nomogram of the psychrometric formula.—M. **Pavillard**: Increase and scissiparity in the Peridineans.—J. **Basset**: Preserved food for the armies in the field. Modifications of the existing ration are suggested with a view of giving greater variety of food.—H. **Vincent**: Experimental vaccination against the cholera bacillus by a vaccine sterilised with ether. The advantages of the use of ether are the rapid sterilisation, reduction in the amounts of useless lipoid bodies, and the dissociation of the treated bacilli favourable to their rapid bacteriolysis in glass and their rapid resorption in the body.—Ch. J. **Gravier**: The biology of corals from great oceanic depths.

BOOKS RECEIVED.

The Works of Aristotle, translated into English: De Mundo. By E. S. Forster. De Spiritu. By Prof. J. F. Dobson. (Oxford: At the Clarendon Press.) 2*s.* net.

The Works of Aristotle, translated into English: Magna Moralia. By St. George Stock. Ethica Eudemia. De Virtutibus et Vitiis. By J. Solomon. (Oxford: At the Clarendon Press.) 5*s.* net.

Principles of Physical Geography. By G. C. Fry. Pp. x+151. (London: W. B. Clive.) 1*s.* 6*d.*

First Principles of Production. By J. T. Peddie. Pp. 231. (London: Longmans and Co.) 5*s.* net.

Modern Illuminants and Illuminating Engineering. By L. Gaster and J. S. Dow. Pp. xiv+462. (London: Whittaker and Co.) 12*s.* 6*d.* net.

Essays towards a Theory of Knowledge. By A. Philip. Pp. 126. (London: G. Routledge and Sons, Ltd.) 2*s.* 6*d.* net.

"Rain and Rivers." The Rev. Prof. Bonney and the late Col. George Greenwood. Pp. 16. (London: Watts and Co.) 3*d.*

Board of Education. Memorandum on the Teaching of Engineering in Evening Technical Schools. Pp. 59. (London: H.M.S.O.; Wyman and Sons, Ltd.) 6*d.*

A History of the Royal Dublin Society. By Dr. H. F. Berry. Pp. xv+460. (London: Longmans and Co.) 15*s.* net.

The Problem of Volcanism. By Dr. J. P. Iddings. Pp. xvi+273. (New Haven: Yale University Press; Oxford: University Press.) 21*s.* net.

Œdema and Nephritis. By Dr. M. H. Fischer. Second edition. Pp. x+695. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 21*s.* net.

DIARY OF SOCIETIES.

WEDNESDAY, APRIL 7.

ENTOMOLOGICAL SOCIETY, at 8.

FRIDAY, APRIL 9.

ROYAL ASTRONOMICAL SOCIETY, at 5.

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